THE

# ELECTRICAL REVIEW.

VOL. LVI. MARCH 31, 1905. No. 1,427.

## ELECTRICAL REVIEW.

Vol. LVI.] CONTENTS: March 31, 1905. [No. 1,427.

| | Page |
|---|---|
| Temperature Limits for Electrical Machinery ... ... ... | 513 |
| The Electric Smelting of Iron and Steel (*illus.*) ... ... | 516 |
| Cranes for Extra Heavy Lifts ... ... ... ... ... | 518 |
| Institution of Electrical Engineers:— | |
| Temperature Curves and the Rating of Electrical Machinery (*illus.*) ... ... ... ... ... ... | 518 |
| Physical Society ... ... ... ... ... ... ... | 521 |
| Legal ... ... ... ... ... ... ... | 521 |
| The Holborn and Finsbury Electrical Exhibition (*illus.*) ... | 523 |
| The Paddington Electrical Exhibition ... ... ... ... | 524 |
| Correspondence ... ... ... ... ... ... | 524 |
| The Telegraphone Improved (*illus.*) ... ... ... ... | 526 |
| Business Notes ... ... ... ... ... ... ... | 527 |
| City Notes ... ... ... ... ... ... ... ... | 536 |
| Stocks and Shares ... ... ... ... ... ... ... | 540 |
| Share List of Electrical Companies ... ... ... ... | 541 |
| Electric Tramway and Railway Traffic Returns ... ... | 542 |
| Exports and Imports of Electrical Goods during February, 1905 | 543 |
| Parliamentary ... ... ... ... ... ... ... | 544 |
| Our Legal Query Column ... ... ... ... ... ... | 548 |
| The Agricultural Hall Motor-Car Show ... ... ... ... | 549 |
| Visitors Day at Bushy House ... ... ... ... ... | 550 |
| Bimetallic Rheostats (*illus.*) ... ... ... ... ... | 550 |
| The Boston Turbo-Generator Station ... ... ... ... | 551 |
| New Patents Applied For ... ... ... ... ... | 552 |
| Published Specifications ... ... ... ... ... ... | 552 |

THE

UNIVERSAL ELECTRICAL DIRECTORY

**1905 Edition**

**NOW READY.**

PRICES, POST FREE:

| | |
|---|---|
| In Great Britain .. | .. 14s. |
| British Colonies .. | .. 15s. |
| U.S.A. (duty free) | .. 18s. |
| Other Countries | .. 16s. |

**Order at once.**

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

**Published every FRIDAY, Price 4d.**

*The Oldest Weekly Electrical Paper. Established* 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

***OFFICE:—4, LUDGATE HILL, LONDON, E.C.***

Telegraphic Address: "AGNEKAY, LONDON." Code, A B C.

Telephone No. 933 Holborn; 4425 Central.

*ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.*

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

***BY FAR THE LARGEST CIRCULATION***

of any Electrical Industrial Paper in Great Britain.

*SUBSCRIPTION RATES.*—In Great Britain, Post Free, per Year, 19s. 6d. To all other countries, per Year, £1 10s.

*BINDING.*—Subscribers' numbers bound, including case, for 4s. each volume.

*CASES.*—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

*READING CASES,* to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

*FOREIGN AGENTS.*—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

## TEMPERATURE LIMITS FOR ELECTRICAL MACHINERY.

As mentioned in our last issue, the Sub-committee on Physical Standards has issued to the Engineering Standards Committee a report on the temperature experiments which have been carried out by Mr. Rayner under the direction of Dr. Glazebrook, at the National Physical Laboratory. It is to be hoped that the main committee will now be in a position to formulate its recommendations as to the standardisation of the temperature rise to be permitted in electrical machinery.

The report constitutes a very interesting and valuable record of the investigations in question. One remarkable feature constantly in evidence, which we feel bound to criticise, is that, from a reading of the report, the impression is conveyed in many cases that certain important phenomena have on this occasion been observed for the first time. The only allusion to the work of others is a reference to a paper by Brown, entitled, "The Rise of Temperature in the Field Coils of Dynamos" (*Proceedings of the Institution of Electrical Engineers*, Vol. XXX. (1901), p. 1159). It is far from our intention to depreciate the present very careful, painstaking and interesting investigation, but in view of information which had already been published several years ago, and which leads to substantially the same conclusions as have been arrived at by this later investigation, we do not see the necessity for having delayed the recommendations concerning the standardisation of the temperature rise, pending the completion of these tests.

As stated in the report, the permissible temperature of field spools is dependent mainly upon the properties of the cotton coverings of the copper conductors. The tests regarding this point led to the conclusion that a temperature of 125° C. could not be exceeded without the risk of impairing the insulation of these cotton coverings, and that this limit was only safe in cases where the moisture had been completely and finally expelled from the cotton coverings; for when even slight traces of moisture are present, a serious leakage may occur, since the ohmic insulation resistance of many *dry* insulations is halved for, say, every 7° C. increase in temperature. Hence with 80° to 100° C. increase in temperature, the ohmic insulation resistance is but a small fraction of the value at, say, 30° C. If even a slight trace of moisture is present, the insulation resistance is again reduced many-fold. It is pointed out in the report that the weight of the cotton covering often comprises some 5 per cent. to 7 per cent. of moisture, which may be expelled by heating.

Everything mentioned up to this stage has already been pointed out years ago by others. One point on which we do not remember to have seen any experimental results, relates to a quantitative investigation of the rate at which

the insulation resistance of a cotton covering varies with the percentage of contained moisture. The results could be expressed in terms of the percentage reduction in insulation resistance for 1 per cent. increase in moisture in the cotton covering. We suggest that this would be a useful and original subject for investigation, and we believe that the nature of the results would be such as to lead to the far more general use of vacuum ovens in the electrical industry.

Vacuum ovens are not even so much as mentioned in the report, although we find occasional reference to the set-backs in the work due to a tardy discovery that the omission of sufficient preliminary "stoving" necessitated a repetition of tests. The report also takes due note of the fact that cotton coverings from which moisture has been carefully expelled rapidly take up from the surrounding atmosphere some 4 per cent. to 7 per cent. of their weight in moisture. This should lead to a careful consideration of the question not only of impregnating the insulations with some suitable varnish, but also of filling up all interstices between conductors, with some suitable insulating compound. This may be done by thoroughly exhausting the air from the coil in a vacuum chamber, and then filling it in solid under pressure. Not only will moisture be thus effectively excluded, but, by the right choice of impregnating materials, the emissivity of the coil may be greatly improved. The report describes a field spool which appears to have been treated in substantially this manner, in which a decrease of over 25 per cent. in the temperature rise of the coil was thus attained. There are on the market several materials for such a purpose, and it would be of interest to have comparative tests of the results obtained by impregnating otherwise identical coils with these various materials.

A large part of the report is devoted to a description of an investigation in which, for nine different designs of field coils supplied by several manufacturers of electrical machinery, observations were made of the percentage by which the maximum temperature in the interior of the coil, as determined by thermo-junctions, exceeded the temperature as obtained by resistance measurements. The excess was found to amount to over 15 per cent. in a good many instances.

At this point we must revert to the subject of cotton coverings, and call attention to the results of Dettmar's* investigations, completed in 1900, on the effect of temperature on the cotton coverings of copper wires. Dettmar made a series of deterioration tests at 95° C., withdrawing and testing numbers of samples at pre-arranged intervals. After 100 hours, no change in the cotton covering was observable. After 500 hours, a slight discoloration was apparent, and a decrease in the flexibility could be observed in the cotton covering on bending the wire sharply. After 1,000 hours, the discoloration and the decrease in flexibility were more pronounced. Dettmar concluded that while 95° C., or even more, may be permissible for stationary windings, it should be regarded as the extreme upper limit for windings subject to vibration, such as occur in the coils on rotating armatures. Similar tests at 115° C., also for 100, 500 and 1,000 hours, resulted in such pronounced deterioration as to lead to the conclusion that so high a temperature should not be permitted. Another group of tests with paper-insulated wires showed that in that case a temperature of 115° C. could be permitted with perfect safety.

In view of Dettmar's tests, which are accepted as authoritative by the German Association of Electrical Engineers, it would hardly be conservative to assign to the highest temperature, to which there should be any probability that the cotton coverings of the turns of the field magnet windings would be exposed, any value higher than 100° C. Taking this figure, then the highest value of the temperature, as determined by measurements of the resistance of the coils, should not be permitted to exceed 87° C. Electrical machinery is often required to operate in places where the surrounding temperature permanently or occasionally reaches 35° C. Hence there remains 52° C. as the highest permissible temperature increase as determined by measurement of the increase of resistance, if we wish by means of a general rule to ensure that the quality of the cotton coverings shall not be impaired by the temperature to which they are exposed. This final deduction is our own, and it may be useful to go on with, pending the issue of an authoritative recommendation from the Standardising Committee.

As to thermometric measurement of the temperature of field coils, we thoroughly agree with the position taken up in the report, that this method should make way for the more exact method by means of resistance measurement. One finds, however, from the National Physical Laboratory tests on these nine coils, an average value for the temperature, as thermometrically determined, of less than 65 per cent. of the value determined by measurement of the electrical resistance, and hence, in cases where thermometric measurements are employed, a temperature rise of more than 35° C. above the surrounding air could not consistently be permitted.

It will be interesting to see how it is proposed to square these facts with the intimation contained in the interim report of the Sub-Committee, to the effect that the temperature limits ultimately to be recommended are likely to be more liberal than those laid down by either the American or German Electrical Standardisation Committees. It has always seemed to us that apparatus of Continental manufacture is rated decidedly too high as regards the temperature rise permitted, although we admit that the high output obtained per unit of weight is in great part legitimately obtained by the excellence of the designs as regards ventilation.

* "Ueber die Nothwendigkeit der Aufstellung von Normen für die Bestimmung und Angabe von Leistung, Erwärmung und Wirkungsgrad elektrischer Maschinen."—Georg Dettmar, *Elektrotech. Zeitschr.* Vol. xxi., August 23rd, 1900, p. 727.

---

Extravagance in Power House Architecture.

Ostentation in the dress or environment of a private person, if not due to vulgarity, is regarded as a desire to advertise. For example, a smartly-turned out carriage, be it brougham or motor-car, is to the doctor what a street sign is to a grocer. To him it has a direct money value; and where advertisements pay for themselves, there can be obviously no objection to them from an economic point of view.

This argument may be applied, with perfect propriety, to buildings erected for business houses where an impression of opulence will promote good trade. But in engineering works' construction an attempt to combine beauty with utility is, in our opinion, bad taste, and worse finance. The impression gained on going into a building on which money has been lavished in this way is, not that the company or corporation owning the power house is enormously wealthy, but that a large amount of capital has been permanently sunk without a chance of its ever yielding a profit. A case in point came under our notice recently in examining the design

of a large power station. The roof trusses, which, according to engineering conceptions, should be as simple and strong as possible, were embellished with scroll and latticework, which would have looked very well on a park gate, but was distinctly foreign to the design of a power house. There are many instances of enamelled brick having been carried right up the walls to the roof. The cost of a glazed brick is nearly double that of a good stock one, and special shapes—such as bull-noses and mouldings—are even more expensive. Frequently the absurdity is heightened by the use of glazed bricks for the walls, and ordinary stock bricks for the outside of the boiler setting, where a glazed surface would be of some use in reducing boiler heat radiation and air leakage. Other instances may be cited, such as the extravagantly ornate hand-rails, the expensive floorings, the paint and lacquer, very pleasing to the eye of a Town Councillor, but a perfectly definite burden on the rates. We should be the last to advise parsimony in legitimate engineering construction, or even to discourage expense in experiment in the initiation of a power scheme; but we do object to the expenditure of unproductive capital to produce an effect which is, after all, not artistic. Neatness can be gained without extravagance.

It has been suggested to us that so long as the present system prevails of paying a consulting engineer so much per cent. on the capital outlay, and possibly allowing him to enlist the services of an architect whose fees may also be proportional to the magnitude of his scheme, this form of waste will continue; but we should be sorry to believe that professional men of the dignity of consulting engineers would permit themselves to be influenced by motives more sordid than a rather excessive love of display.

---

The Simplification of Station Design.

Another proof that complication of process usually indicates confusion of thought, and that extreme simplicity is generally the outcome of sustained calculation and experiment, is given in the design of the new power station of the Edison Electric Illuminating Co., of Boston, which we briefly describe in another column. An output of 60,000 KW. is to be provided by units each of 5,000 KW. capacity, each steam and electrical unit, with its auxiliary apparatus, being complete in itself. A row of boilers placed immediately behind the turbine feeds each generator by a direct line of steam piping, this being the simplest design possible; a small cross-connection from each line to its neighbour on one side for emergency operation is the only complication introduced into the pipe-work. From the coal pile to the bus-bar, the paths of energy transmission through the station cannot be diverted except in extreme emergencies, and this fact is eloquent of the certainty which characterises modern design. Moreover, clearness of conception has been evidenced in the definition of the duties assigned to each class of operatives. The foremen have no longer to supplement boiler tending with rudimentary engine driving; the boiler feed-pumps are in this station placed in their proper situation—the machinery room. All the electrical control apparatus is grouped together in a separate building adjoining the turbine room. The advisability of removing the switchman from the engine room may be questioned, as this operator frequently receives his first warning of trouble by ear rather than by eye; but the idea of natural limitation of responsibility by geographical boundaries is so good, and the number of disasters that have occurred in time past and in many stations through careless definition of duties so great, that we recommend the method as worthy of development in future design. The days of equipping a station with the greatest possible number of devices for dodging disaster are past; central station plant is now expected to operate with certainty and reliability.

---

Motor-'Buses.

We have lately devoted a good deal of our space to a consideration of the motor-'bus *v.* electric tramway controversy. Another contribution to the subject, and one that is not without special significance, is to be found among our "Tramway Notes" to-day; we refer to the decision of the South Shields Corporation to proceed at last with its electric tramway undertaking. This decision, it should be observed, has been arrived at by an overwhelming majority of the councillors, after full investigations have been made regarding the advantages which some have claimed for the motor-'bus as a substitute for the tramway. In the absence of practical data as to working costs of motor-'bus services, and in view of the many other points which we have already urged, the disinclination to spend public money upon doubtful experiments is but reasonable. We are glad that the South Shields municipal representatives have displayed so much commonsense, a quality which is lacking in the case of some corporations when there is a chance for adopting something new and untried.

---

Municipal Trading Again.

The case of the Attorney-General on the relation of the Willesden Urban District Council *v.* the Metropolitan Electric Supply Co., which was decided in the Court of Appeal on March 24th, has already been fully dealt with in these columns (Electrical Review, November 4th, 1904). It affords an example of the way in which municipal authorities supplying electricity seek to prevent electric supply companies from entering into competition with them. In 1889 the Metropolitan Co. obtained statutory power to supply electricity in a certain metropolitan district upon terms that they should not supply energy elsewhere except under the authority of Parliament. In 1898 they obtained power to establish a generating station at Willesden, and this Act enabled them to lay cables from Willesden to the areas in which their supply in the metropolis was authorised. In 1903 the company began to supply energy to the London and North-Western Railway Co. for use in their sidings at Willesden. The Willesden Urban District Council then set the Attorney-General in motion, in order to put a stop to this competition with it, and the Courts have held that an injunction must be granted. It is stayed, however, pending an appeal to the House of Lords. It will be interesting to see whether the London and North-Western Railway will allow themselves to be coerced by proceedings of this kind into taking a supply from the District Council.

---

What is a "Pertinacious" Current?

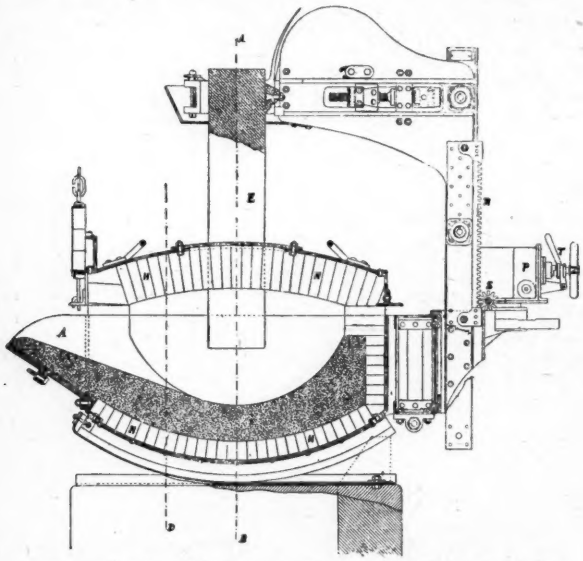
This question must have come into the minds of many of late; but Sir Oliver Lodge has now satisfied our curiosity. It seems that, by the employment of a modified form of the Cooper-Hewitt mercury rectifier, Sir Oliver has succeeded in producing a uni-directional current at very high pressure from the secondary of an induction coil. The current so obtained is, of course, intermittent, but by using it to charge Leyden jars, which maintain the flow of electricity between successive pulses, Sir Oliver obtains a continuous, or *pertinacious*, current of electricity at a pressure of half a million volts, whose ability to find a mode of flowing through any leak or high resistance explains the choice of epithet. Thus, the static influence machine, which previously shared with batteries consisting of great numbers of cells the distinction of being the sole source of such currents, has been superseded, and the much more convenient induction coil, energised from any A.C. supply mains or from a D.C. source through an interrupter, takes its place. Crookes tubes can, of course, be kept continuously excited by the pertinacious current, thus reducing the duration of X-ray exposures; but the object, towards which Sir Oliver Lodge has been more directly working, is the dissipation of fog by the discharge from points. This cannot be done efficiently with an A.C. discharge, the uni-directional discharge being far more effective; we sincerely trust that the distinguished inventor's efforts to overcome the fog nuisance, which have already given great promise, will be crowned with success.

As regards the pertinacious current, this will be useful in many other ways, some perhaps quite unexpected, and we have no doubt that many physicists will find a fruitful field for investigation opened for them by Sir Oliver Lodge's ingenious arrangement.

## THE ELECTRIC SMELTING OF IRON AND STEEL.

The March meeting of the Faraday Society, held on Monday the 6th inst., was devoted to the reading and discussion of an important paper by Mr. F. W. Harbord, entitled "Recent Developments in Electric Smelting in Connection with Iron and Steel." The paper embodies the results of the investigations made by the Commission sent to Europe last year by the Canadian Government, whose enterprise and foresight are deserving of all praise, together with some additional information by which the author brought the subject fully up to date. We have already drawn attention to the report of the Commission (Electrical Review, December 23rd, 1904, p. 1017).

Bearing in mind the purely English aspects of the subject, we propose to deal here only with those furnaces and processes described by Mr. Harbord which have direct reference to the conditions under which the manufacture of steel can be carried out economically in this country. The cleverly-designed Kjellin furnace, which is only suitable for



Vertical section through the Pouring Spout of the Héroult Furnace at La Praz.—A, Pouring spout; E, Suspended electrode, of which there are two, passing through roof; H, Basic or burnt Dolomite bricks; H', Silica bricks of roof; K, Rammed basic material; P, Motor for driving automatic regulator; T, Lever for throwing motor P out of action; Z, Hand-wheel operating pinion S' for regulating electrodes by hand; R, Rack gearing with S, by which electrode is raised or lowered. An alternating current of 4,000 amperes and 110 volts is used.

Fig. 1.—Transverse Section at E F.

melting down pig and scrap of the very highest purity—such as is easily obtained in Sweden, where the furnace is in operation—may therefore be dismissed in a very few words. The Kjellin is an induction furnace, practically a step-down transformer, in which the contents in the hearth form the secondary circuit. That in operation at Gysinge has an output of about 5½ tons per 24 hours, and it absorbs from about 0·13 to 0·16 E.H.P.-year per ton of ingots, according to the carbon content of the product.

The majority of the speakers who took part in the discussion agreed with Mr. Harbord that the Keller and Héroult were the only furnaces that had up to the present been developed, which could be adapted to the requirements of English steel smelting, and there seems to be a general consensus of opinion among those who have made a special study of this subject that for the manufacture of steel alloys, such as ferro-chrome, ferro-silicon, and ferro-vanadium, and special steels of high quality, such as used for cutting tools, guns, motor-cars, safes, &c., this type of furnace can, and should, be adopted in England, which is now almost the most backward country in the world as far as electric smelting is concerned. In the opinion of the Commission either of these processes is able to compete successfully with the Sheffield crucible furnace, even if electrical energy costs as much £10 per E.H.P.-year, and authorities like Prof. E. Wilson and Mr. R. L. Gamlen (of the Lancashire Electric Power Co.), have no doubt that this figure could be considerably lessened, even in England, by the production of energy on a large scale. One must also bear in mind in this connection the possibilities of blast furnace gases, of which Mr. Thwaite, with such admirable persistence, is never tired of reminding British engineers; "the harnessing of this waste," said Mr. Thwaite, "to an electro-metallurgical steel process, should secure the all-important factor of commercial economy."

The Héroult process, the invention of the distinguished French engineer who has done so much for the development of the aluminium industry in Europe, has been used to a larger extent commercially than any of the others described by Mr. Harbord, for by it, as M. Minet pointed out in his interesting contribution to the discussion, over 3,000 tons of steel have been produced, and the Société de Froges has been placing this steel on the market for the past two years. Héroult has up to the present erected a 4-ton furnace at Kortfors, in Sweden, and a somewhat smaller one at La Praz, in the south of France, and in these furnaces common steel scrap of good average quality is being converted to steel of the very highest quality, the impurities being removed by

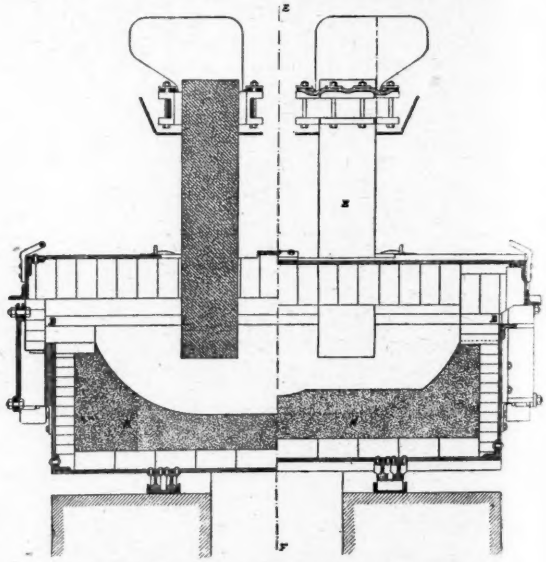


Fig. 2.—Longitudinal Sections at A B and C D.

suitable fluxes in the usual way. The process is claimed by M. Minet to be unique, is so far as it allows of a complete elimination of sulphur and phosphorus. Steel varying from 0·079 to 1·000 per cent. carbon is made with perfect ease, and as far as mechanical and workshop tests are concerned, Mr. H. F. Donaldson, of the Woolwich Ordnance Factory, found little difference between electric steels (Kjellin, Héroult and Keller) and the high class Sheffield steel known as grade "A."

The Héroult furnace is a basic-lined tilting furnace, two large carbon electrodes, preferably water-jacketed, passing vertically through the roof. These electrodes can be raised or lowered, either by hand or automatically, and by this means the intensity of the current passing through the bath can be regulated to a nicety. Mr. R. S. Hutton very rightly pointed out that as the current passes from the electrodes to the molten charge, not direct but through two arcs respectively, this type of furnace is really a combination of arc and resistance furnaces, and to this its value is to a certain extent due. The arcs form two sources of intense heat, which tend to promote rapid convection currents between the slag and the steel, and thus to expedite the reaction and bring about uniformity of product. At La Praz an alternating current of 4,000 amperes at 110 volts is used for operating the furnace, which absorbs about 0·111 E.H.P.-year per ton of ingots in the case of low-carbon steel, and about 0·17 E.H.P.-year for high-grade carbon steel. In addition to the cost of electrical energy, there has to be taken into account the cost of electrodes, equivalent to about 10d. per ton of steel, and of repairs, &c., which works out at about 5s. 10d. a ton.

According to latest information, M. Héroult has now increased his output at La Praz to 7 tons in the 24 hours, and Mr. W. Murray Morrison informed the meeting that the inventor was now constructing a 300-ton mixer and a 50-ton furnace, from which striking results were anticipated. Indeed, even now Héroult has reduced his energy figure to 0·15 E.H.P.-year per ton of steel, starting with scrap, and to the remarkable figure of 0·0114 E.H.P.-year (equivalent to 2s. 4d. a ton), starting with molten metal. It should be remembered in this connection, as Mr. Hutton reminded the meeting, that electric heating is only economical when very high temperatures are desired, and that it is not therefore desirable to make use of electric furnaces for melting the charge. They should always be used in conjunction with blast or other furnaces.

The Keller furnace (fig. 3) is identical in principle with the Héroult furnace, but at the works of Keller, Leleux & Co., at Livet, alloys—45 to 60 per cent. ferro-chromes and 25 to 80 per cent. ferro-silicons—and not steel, are being made in it commercially. Mr. Harbord, however, saw steel made from common scrap in an experimental 35-cwt. furnace, the energy absorption being about 0·120 E.H.P.-year per ton of ingots. Experiments were also made at Livet to demonstrate the possibility of making pig-iron electrically, and it was found quite easy so to regulate the charge and the temperature, that any grade of iron, grey or white, could be obtained, varying in composition to suit the requirements either of the acid or basic Bessemer, the acid or basic Siemens, or the foundry, and the change from one grade to another was effected more rapidly than is possible in the blast furnace. The furnaces at Livet are vat-shaped, and connected at their lower ends by a central well; four are usually grouped together. The current used in the trial runs varied between 10,600 and 12,000 amperes, at voltages from 63 to 68, and the energy absorbed was 0·25 H.P.-year per ton of pig for a white iron containing little silicon and manganese, and 0·53 H.P.-year for a grey iron more silicious. The coke used averaged 767 lb. per ton of pig-iron produced, and the estimated cost of electrodes was 3s. 6d. per ton of iron.

From a commercial point of view, the manufacture of pig-iron in the electric furnace is of little interest to the English electrician or metallurgist, as, with our cheap supply of fuel, no electric furnace can compete with a modern blast furnace. In Canada the conditions are different, as in some districts they have immense deposits of iron ore available, as well as water-power, while no fuel suitable for blast furnace purposes can be obtained except at prohibitive prices. Electric energy is actually being distributed in some parts of Canada for less than $10 per E.H.P.-year, so that the possibility of developing their iron ore resources by the electric furnace is a matter of great importance to the colony, since, with electric energy at $10 and coke at $7 a ton, the cost of production of pig-iron is approximately the same as in a modern blast furnace. In various other countries, such as Brazil and the Argentine Republic, and other parts of the world where blast furnaces are impossible at present, the electric furnace might do excellent work.

The only other practical furnace of importance described by Mr. Harbord was the well-known Stassano furnace, which has been working regularly at Turin since last March, producing the grade of steel required by the Italian Government for the manufacture of artillery projectiles. In this furnace steel is produced direct from the ore—briquetted with flux and carbon—in one furnace, but it would be unsuitable for application in England, because, quite apart from the energy consumption, the ores used are the very purest hematites, such as found in northern Italy. The Stassano is an arc furnace, in which the heat is obtained by direct radiation and by reflection from the roof and sides of the furnace; the arc itself takes no part in the reduction of the ore. The latest type in use at Turin has an output of 5 tons per 24 hours, and absorbs 4,900 amperes at 150 volts, the current being distributed between two arcs, and therefore four electrodes, which meet at the centre of the furnace. The furnace is lined with magnesite bricks. The energy consumption is 0·186 E.H.P.-year per ton of steel, and the consumption of electrodes 5 kg. per ton of steel.

Two other processes referred to by Mr. Harbord are of theoretical interest only, as they do not appear to have been tried up to the present on a practical scale. In the Gin furnace, which is of the resistance type, it is proposed to dispense with carbon electrodes, using instead large water-cooled block terminals, which lead the current into a long basic-lined, narrow channel that forms the furnace hearth. The author was of opinion that the difficulty of charging such a furnace while working, and of maintaining the hearth in fair repair, would greatly militate against its

The Keller Electric High Furnace with a plurality of Hearths

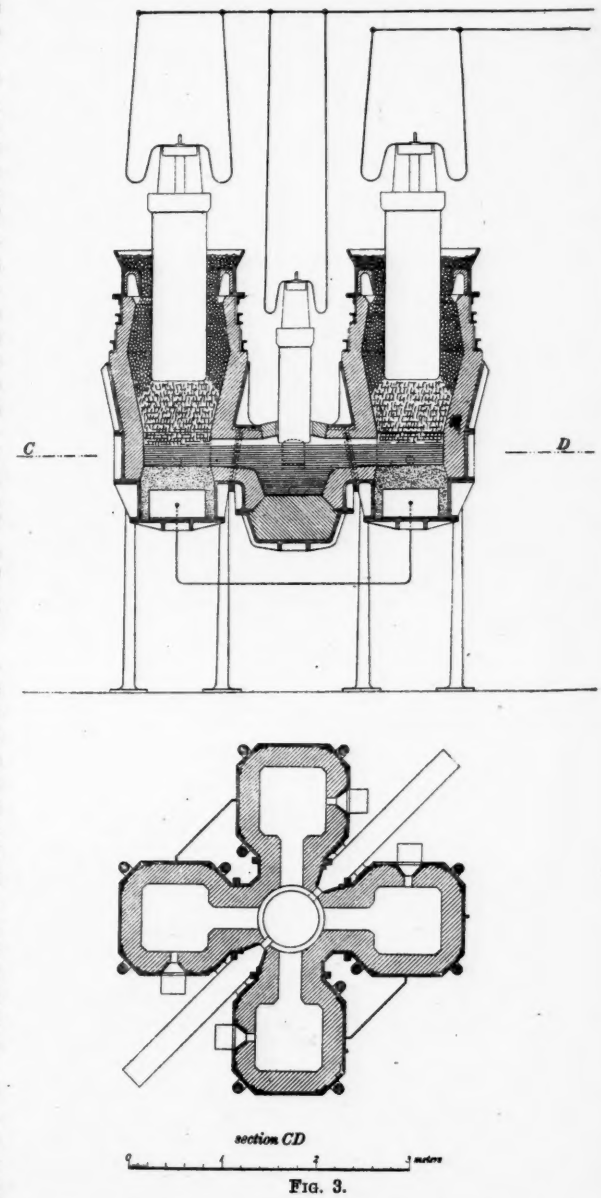



FIG. 3.

success on a commercial scale. M. Harmet, in his suggested form of furnace, melts oxides of iron in a vertical shaft by means of producer gas, and reduces them by solid incandescent carbon; in another form, carbonic oxide is his chief reducing agent. Here again the process has not yet been experimented with on a commercial scale.

The reading of the paper was illustrated by means of an interesting series of lantern-slides, and on the table were exhibited some specimens of steel and ferro-alloys made by the Héroult furnace, kindly lent by M. Minet, of Paris.

We would, in conclusion, reiterate the contention which was put forward so forcibly by Mr. Blount in the discussion that followed Mr. Harbord's valuable paper, that *now is the time* to apply electro-metallurgical methods to the steel industry of this country. The production of special steels and ferro-alloys is difficult by the older methods of heating;

it is manageable and easy in the electric furnace. It is therefore sincerely to be hoped, as Mr. Blount said, "that the facts ascertained by the Commission and presented by Mr. Harbord will encourage the serious examination and free adoption of electrical steel manufacture in this country."

## CRANES FOR EXTRA HEAVY LIFTS.

By E. KILBURN SCOTT, M.I.E.E., A.M.I.C.E.

Some time ago the representative of a large firm of hydraulic crane builders cast doubts on the ability of electrical cranes to handle heavy guns for warships, or complete trucks of coal. He was, of course, thinking of the hydraulic accumulator, which is such an important adjunct to the hydraulic crane, and so hard to beat for simplicity, cheapness and efficiency. It is clear that, on account of the extremely varying load, if large electric cranes are to be employed at all for such purposes, they must be used in conjunction with electric accumulators.

The conditions to be met are somewhat similar to those on an electric tramway having only a very few large cars running, and for such work the reversible booster has been successfully employed for some years both on the Continent and in this country. The reversible booster has the great advantage of enabling the main dynamo to work at a steady load, sending current into the battery or into the outside circuit, just as may be required, the action being entirely automatic.

In a particular case with which the writer had to deal, and which was the first example of the kind in England, the dynamo normally gave 100 amperes at 315 volts, whilst the cranes on occasion might take as much as 350 amperes. When the cranes were making a heavy lift, the balance of the current of 250 amperes was supplied momentarily by a storage battery.

When charging, the booster adds about 15 volts to the dynamo pressure, and when discharging, the total ampere-turns due to the series coils completely overcome the ampere-turns of the shunt coils. The magnetism of the field magnets is thus reversed, and about 20 volts added to the battery discharge, so that the pressure at the cranes is kept about constant.

There are other ways of effecting the same results—for example, with the Highfield machine—but the writer has not heard of its being applied to crane work.

It will be clear from the above that in the reversible booster and the storage battery the electrical engineer has two helpmates which will enable him to successfully undertake the very heaviest work he may be called upon to tackle—in fact, anything which is to-day done by steam or hydraulic power.

## INSTITUTION OF ELECTRICAL ENGINEERS.

### TEMPERATURE CURVES AND THE RATING OF ELECTRICAL MACHINERY.

By Rudolf Goldschmidt, Associate Member.

(*Abstract of Paper read March 9th*, 1905.)

#### I.—Short Time Rating.

The energy lost in electrical machines is converted into heat, which causes the temperature of certain parts to rise above that of the surrounding atmosphere. If no dissipation of heat took place at all, the temperature would simply continue to increase in proportion to the time.

The following is a practical method of measuring the specific heat of copper and iron:—"3·5 watts lost in 1 cb. cm. of copper or iron raises its temperature 1° C. per second, supposing that no radiation takes place," or in British units—"32 watts lost in 1 cb. in. of copper or iron raises its temperature 1° F. per second."

In many cases in practice an instrument is used for a few minutes only, and not more than once or twice a day, for instance, with apparatus, such as starting transformers, the choking coils of single-phase motors, the small motors used for starting synchronous motors, &c. In these cases it is useless to apply the well-known "watts per sq. in." rule for calculating the temperature, and it is a mistaken idea, in designing these machines, to take into consideration the providing of any cooling surfaces.

We may suppose a choking coil or starting transformer to be so dimensioned that, if used only once a day for a period of, say, five minutes as a maximum, the temperature rise in any part will not exceed 16½° C. The frequency is to be 100 cycles per second, and we may assume that the excessively long starting period of five minutes is due to the fact that heavy weights have to be accelerated with a very low starting current. The temperature increase per second is 0·055° C. Since a rise of 1° C. per second is caused by 3·5 watts per cb. cm., the energy lost in 1 cb. cm. must in this case be $3{\cdot}5 \times 0{\cdot}055 = 0{\cdot}19$ watt.

Considering first the heating of iron parts, a curve, showing the hysteresis loss per cb. cm. at different flux densities, shows that at 100 periods the flux density corresponding to 0·19 watt loss per cb. cm. (3·1 watts per cb. in.) is about 15,000 C.G.S. per cm².

With regard to the heating of the copper winding, a copper wire 100 cm. in length and 1 mm.² section has a resistance of about 1/55 ohm; its volume is 1 cb. cm. To cause a rise in its temperature of 0·055° per second, 0·19 watt must be lost in the wire. The current causing this loss in 1/55 ohm would be 3·2 amperes, or 2,000 amperes per sq. in.

We are, therefore, by the aid of an example, enabled to formulate the following rule:—

"Machines which are to work only for a short time, with interruptions sufficient to allow them to cool down to the temperature of the atmosphere, must be so designed that the flux density and copper density do not exceed a certain amount, independent of size and cooling surface."

We can further conclude that with short-period apparatus, the flux density is practically only limited by the permeability of the iron, and not by the heating, since it is possible even under the severe conditions stated, to work at the high flux density of 15,000 C.G.S. per cm².

In the example a current density of 3·2 amperes per mm.² corresponds to $w_v = 0{\cdot}19$ watt per cb. cm., and to a temperature increase v of 0·055° C. per second. As the watts are proportional to the square of the current density, if we denote the latter by the symbol $i$, we have—

$$w_v = 0{\cdot}19 \frac{i^2}{3{\cdot}2^2} = 0{\cdot}019 \times i^2 \text{ watt per cb. cm.}$$

$$v \text{ per sec.} = 0{\cdot}055 \times \frac{i^2}{3{\cdot}2^2} = 0{\cdot}0055 \times i^2 \text{ deg. C. per sec.}$$

In determining the section of the wire by means of these data, we are sure of an ample margin of safety, as the loss of heat by dispersion has not been taken into account. To be quite accurate, however, a slight increase should be allowed in the temperature values in these tables to compensate for the increase of resistance with rising temperature.

There is still to be taken into account the effect of the insulation. In a field coil consisting of average-sized wire, the cotton insulation forms about 5 per cent. of the total weight. Assuming cotton to have six times the specific heat of copper, the average value of the specific heat for the coil is $1 + {\cdot}05 \times 6 = 1{\cdot}30$ times higher than that of copper alone. The average temperature increase per second might therefore be found to be $\frac{1}{1{\cdot}30} = 0{\cdot}77$. With a totally enclosed stationary machine, the heat dissipated is only a small percentage of that stored in the heated body itself, say, during the first hour of heating. The following are approximate values for the time during which the apparatus can be considered as giving out no heat:—

| | | | |
|---|---|---|---|
| Revolving machines, | open... | ... | 20 minutes. |
| " | totally enclosed | ... | 40 " |
| Stationary | " | open... | ½ hour. |
| " | " | totally enclosed | 1 " |
| Starting resistances and, generally, single wires | | .. | ½—2 minutes. |

#### II.—The Temperature Curve.

The temperature of an apparatus will be supposed to have attained a constant value within a few hours. This constant temperature is dependent on the lost watts, on the ventilation, on the cooling surface, and on the temperature of the surrounding atmosphere.

For the sake of simplicity, we will assume in the following investigations that the air is at zero temperature. With a given amount of ventilation, the difference in temperature between machine and atmosphere is directly proportional to the watts dissipated from one unit of surface. A difference in temperature of 90° F. dissipates 0·21 watt from every square inch of surface, or 1/430 watt per square inch per 1° F. rise. In C.G.S. units: 1/1,500 watt is dissipated by 1 square centimetre of surface for an increase in temperature of 1° C.

We will denote by the symbol $c_h$ (heating constant) the factor $\frac{1}{1{,}500}$.

The watts dissipated per unit of surface, we will call "surface watts," symbol $w_s$.

Surface watts = heating constant × temperature difference:—

$$w_s = c_h \times t.$$

With the definitions of volume watts ($w_v$) and surface watts ($w_s$), the rise constant ($c_v$) and heating constant ($c_h$), it will be possible to solve any problem in connection with the temperature rise of elec-

trical machines for intermittent or continuous load, without complex mathematical calculations.

The form of all temperature curves is similar, and having once plotted one, it is applicable to all other cases. The only alteration necessary are the scales of temperature and time.

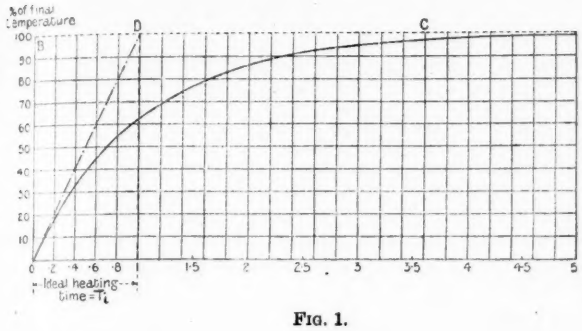



Fig. 1.

An enlarged temperature curve is given in fig. 1, which can be used on any given scale by simply choosing the scale of temperatures so that O B is equal to the final temperature, and the scale of time so that $\frac{O B}{B D}$ is equal to the initial temperature increase.

B D is the time in which the body would have reached the final temperature if no cooling had taken place during the period. To the ideal heating time we will give the symbol $T_i$.

$$T_i = \frac{\text{Volume}}{\text{Surface}} \times \frac{\text{Rise constant}}{\text{Heating constant}}.$$

$T_i$ is dependent only on the constant of the apparatus and on the ventilation, and is independent of the watts lost. In order to determine after what length of time a given machine will approach its final temperature within a few per cent., we have only to examine the curve, which shows that the final temperature is attained within 5 per cent. at the end of three times $T_i$, the ideal heating time. For a commercial temperature test this time ought to be sufficient, as the temperature would be raised only 1½° more after another hour, assuming the final temperature to be 50° C.

A very useful rule for determining the length of time of the temperature test of a machine can be deduced as follows:—It is only required to know (1) what the final temperature is likely to be and (2) the current density. The initial temperature rise is proportional to the square of the current density. For 50° C. the ideal heating time $T_i$ is 1½ hours. From this we can calculate tables of the ideal heating time ($T_i$), say for final temperatures of 50° C. and 75° C. (measured by resistance rise).

TABLE No. I.

| Current density. | | Ideal heating time in minutes for a final temperature of— | |
|---|---|---|---|
| Amps. per square millimetre. | Amps. per square inch. | 50° C. (90° F.). | 75° C. (135° F.). |
| ·25 | 160 | 4,200 | 6,300 |
| ·5 | 320 | 1,040 | 1,550 |
| ·75 | 480 | 460 | 690 |
| 1 | 640 | 260 | 370 |
| 1·5 | 960 | 115 | 173 |
| 1·56 | 1,000 | 107 | 160 |
| 2 | 1,280 | 65 | 97 |
| 3 | 1,920 | 29 | 43 |
| 5 | 3,200 | 10½ | 16 |

The application of Table I. may be shown by some examples:—

*Example* 1.—A continuous current machine is designed for 50° C. final temperature rise. The current density in the field coils is 1,000 amperes per square inch. How long is it to be tested in order to produce a rise of temperature equal to 95 per cent. of the final temperature? Due to its considerably smaller heating constant, the armature has, as a rule, reached the end of its ideal heating time $T_i$ and in consequence, its final temperature, more quickly than the field coils have. Therefore the field coils determine the time of test for a continuous-current dynamo, and if their temperature is practically constant, one can be sure that the temperature of all other parts is also constant.

From Table I. we take $T_i = 68$ minutes for 1,250 amperes per square inch, and from the curve the time of test necessary to bring the parts within 5 per cent. or 2½° C. of their final temperature is $3 \times T_i = 3 \times 68 = 3\frac{1}{2}$ hours. If we were to test this machine for only a little over over 2 hours $= 2 \times T_i$ only 86·6 per cent. of its final temperature would be reached.

It is well known that large machines require a very much longer test than small ones. This is very clearly shown by the formula for $T_i$. Whilst heating and rise-constants do not vary very much with the size, the ratio $\frac{\text{volume}}{\text{surface}}$ increases with an increase of the size.

For the purpose of comparison $\frac{\text{section}}{\text{circumference}}$ may stand for $\frac{\text{volume}}{\text{surface}}$. As an average it may be assumed that 50 per cent. of the total section of the field coils is copper; thus we find—

For a 2-KW. machine, $\frac{\text{section}}{\text{circumference}} = 1{\cdot}3$; $\frac{\text{volume}}{\text{surface}} = 0{\cdot}65$;
„ 50-KW. „ „ $= 2{\cdot}0$; „ $= 1{\cdot}0$;
„ 300-KW. „ „ $= 2{\cdot}7$; „ $= 1{\cdot}35$.

If for the 2-KW. machine a four hours' temperature test is considered sufficient, the 50-KW. machine must be tested 6¼ hours, and the 300-KW. machine must be tested 8¼ hours.

For practical use, the current density will be more convenient for determining the test time than the dimensions. We may therefore conclude by stating that:—

Dynamos with stationary field coils, which are designed for about 50° C. rise, measured by resistance, reach their final temperature within two or three degrees:—

| | Amps. per sq. in. |
|---|---|
| At the end of 1 hour with field current density of | 3,000 |
| „ 3 „ „ | 1,500 |
| „ 6 „ „ | 1,000 |
| „ 9 „ „ | 800 |

### III.—Heating and Cooling.

If a heated body has attained the temperature which we have called the "final temperature," all heat subsequently produced is given out to the surrounding atmosphere.

Referring to our previous example again, we stated that if the body has a temperature of 50° C. above that of the atmosphere, it gives out by radiation and convection as much heat as would increase the temperature of the body at the rate of 0·55° C. per minute. With a temperature of only 35° C., the temperature increases at the rate of—

$$\frac{0{\cdot}055}{50}(50 - 35) = \frac{1}{90} \times 0{\cdot}15 = 0{\cdot}165° \text{ C. per min.}$$

Now we know that the ideal heating time—

$$T_i = \frac{50}{0{\cdot}55} = \frac{\text{Final temp.}}{\text{Initial rise}} = 90 \text{ min.}$$

and is a constant of the apparatus, so that we may say—

$$\text{Temp. increase per min.} = \frac{\text{Final temp.} - \text{Momentary temp.}}{\text{Ideal heating time}}$$

$$E = \frac{tf - t}{T_i} = \left(\frac{50 - 35}{90}\right).$$

We will suppose that the temperature was more than the temperature of equilibrium, 50° C.—say 70° C. We may assume that this temperature was obtained by overloading the apparatus at some time. Then the cooling action is 70/50 = 1·4 times greater than that which just balances the temperature increase of 0·55° C. per minute. Thus, at the instant when the temperature of the body cools down at the rate of $E = \frac{50 - 70}{90} = 0{\cdot}22°$ C. per min., we see that there the calculation of the cooling is the same as that of the heating, and if E is positive it indicates temperature increase, while if negative it indicates a cooling action.

It is important to consider the cooling curve in cases where the development of heat suddenly becomes less. Supposing the lost watts were suddenly reduced by half, then the new final temperature would be ½ × 50 = 25°, and the initial rise ½ × 0·55 = 0·275° per min. If the body had already attained its final temperature of 50° C. during the first instant after the change, the temperature would drop at the rate of $\frac{25 - 50}{90} = -0{\cdot}275°$ per min. At any other temperature the calculation of the temperature drop is equally easy. Proceeding by intervals of 10 or 20 minutes, we can trace the whole cooling curve, which tends to reach the new final temperature of 25° C.

By a complete heating and cooling curve we understand the heating curve rising up to the final temperature, and the drop curve from that temperature down to 0° = air temperature. The rate of the drop in the first moment is $\frac{50 - 0}{90} = 0{\cdot}55°$ C. per minute, being the same as the initial rise. Therefore, we see that the initial rise and the initial drop are identical. The falling curve and the rising curve are identical in form, only reversed. The consequence is that after finding the correct scale in the manner previously described, we can use fig. 1 upside down as a standard cooling curve for every possible case.

Before concluding our investigations on cooling, it may be pointed out that with rotating machines during the cooling period, when the machine is shut down, the cooling conditions generally are worse than those existing when the machine is working. This is due to there being no ventilation when the machine is at rest. When the machine stands still the heating constant (equivalent to cooling constant) of the field coils is about ⅔ of that with the machine revolving at normal speed. This ratio naturally depends on the sort of machine, and on the influence of the armature losses on the field temperature, &c.

### IV.—Crane Rating.

These investigations are of great importance in the design of machines which are only on full load for a few hours, such as lighting transformers, and machines which require an overload for an hour or two. In such cases, the time during which the load is on can generally be determined with tolerable exactitude.

This kind of rating is often called the "short-time rating," from which we have to distinguish machines which are designed for intermittent use for short periods of application and interruption (of a few minutes) briefly called "crane rating." This latter kind of machine is quite distinct from a machine designed for short periods of use and long interruption, which we dealt with in the first part of our study.

The characteristic qualities of crane rating are as follows:—

1. The load has a more or less regular periodic character. This distinguishes crane rating from the short-time rating.

2. The time of use and the time of interruption are so short that during the former the temperature obtained does not come anywhere near the final temperature, and during the time of interruption the apparatus does not cool down to anywhere near the air temperature. In fact, after some hours' run, the maximum and minimum temperatures attained must remain within a few per cent. of the average temperature.

We will first assume that the cooling conditions when the machine is shut down are the same as when the machine is running, and study the question of crane rating on our field coil, the data for which are—

Current density 1·35 amperes per mm.²
Final temperature for continuous run, 50° C.

As we found from the current density, the initial rise is 0·55° per minute, and the ideal heating time $\tau_i = 1\frac{1}{2}$ hours. If we submit the coil to a crane load, consisting of periods of three minutes' heating and seven minutes being shut down, the total period lasting 10 minutes, then in order to obtain the average temperature curve round which the actual temperature fluctuates, we have only to consider that a heating time of three minutes is followed by a cooling time of seven minutes. Since during these short spaces of time the temperature increase or fall in the unit of time can be considered constant, the seven minutes' cooling is as effective as a three minutes' cooling with $\frac{3}{7}$ times increased intensity.

To find the final average temperature we have only to multiply the final temperature for continuous run, 50° C., by $\frac{3}{10}$, and so obtain $\frac{3}{10} \times 50 = 15°$ C.

Considering that three minutes is 3/90 = 3·3 per cent. of the ideal heating time, and that in the short times of three and seven minutes the time and temperature (taken as percentages) are practically proportionate to one another, the positive temperature fluctuation during three minutes is 0·033 × total range of temperature = 0·033 × 35° C. = 1·15° C. The negative fluctuation during seven minutes is 0·077 × total range of drop = 0·077 × (15° − 0) = 1·15° C.

Consequently the final temperature is $15° \text{ C.} \pm \frac{1·15° \text{ C.}}{2}$. The average initial rise is $\frac{3}{10} \times 0·55 = 0·165°$ C. per minute, so that the ideal heating time is $\frac{15}{0·165} = 90$ minutes, the same as with continuous rating. Thus the crane motor requires the same time for heating up as the machine designed for continuous rating. The final temperature is directly proportional to the ratio—

$$\frac{\text{Time of use}}{\text{Time, full period}}$$

under the assumption that when the machine is shut down the ventilation is the same as when it is running.

As stated above, the cooling is much worse while the machine is shut down, because we considered that a reduction of the ventilation of the field coil in the ratio of $\frac{2}{3}$ would occur.

Taking this into account we have—

3 minutes heating,
3 „ cooling with full intensity,
7 „ „ „ $\frac{2}{3}$ of full intensity,

which is equivalent to—

$$\frac{2}{3} \times 7 = 4·7 \text{ cooling with full intensity.}$$

Total equivalent time of cooling with full intensity 4·7 + 3 = 7·7 minutes.

Final temperature $\frac{3}{7·7} \times 50 = 0·39 \times 50 = 19·5°$ C.

The ventilation of the *armature* is, at full speed, three to five times better than when it is stationary, so here we have—

3 minutes' heating,
3 „ cooling with full intensity,
7 „ „ with say $\frac{1}{4}$ of full intensity;

equivalent to $\frac{1}{4} \times 7 = 1·8$ minutes' cooling with full intensity. Total equivalent time of cooling with full intensity = 3 + 1·8 = 4·8 minutes.

Final temperature $\frac{3}{4·8} \times 50 = 0·63 \times 50 = 31°$ C.

If an ordinary continuous rating motor is to be used as a crane motor, the losses in the badly ventilated parts (field coils) can be increased considerably more than in the well ventilated ones (armature). This only holds good if the machine is to be designed for actual crane-working conditions, the time of working and stopping being definitely given.

Usually a crane motor has to stand a one-hour's test on full load, independently of what it has to do in actual practice. Long experience has proved that in nearly every case, a motor which stands this test with a moderate temperature rise, is large enough for crane work. One disadvantage, however, is seriously felt, namely, that the one-hour's test is more severe on small and open machines than on large and totally enclosed ones.

Considering a one-hour's crane test to be correct (load factor, say, 50 per cent.) for small open-type machines, the time of test ought to be:—

For large open-type machines, say ... ... $1\frac{1}{2}$ hours.
For small totally enclosed machines ... $1\frac{1}{3}$ „
For large „ „ „ ... ... 2 „

It would be desirable to find a test which would give accuracy as well as simplicity. A test with the exact conditions given, for instance, with a period of 3 minutes' running and 7 minutes' stopping is somewhat troublesome.

Now, within rather wide limits, the temperature curve can be considered a straight line and, in consequence, the temperature is only dependent on the load factor. Therefore, we could replace the 3 minutes' running and the 7 minutes' stopping by saying 9 minutes' running and 21 minutes' stopping respectively, which would require less attention than the shorter period. We could extend the length of the period a little further still for large machines, and shorten it a little for small machines. This "crane test with extended periods" certainly gives more exactness than the one-hour's test, and enables us to make the expression "crane rating" more definite, and to allow for different load factors. The following is suggested as a simple method of crane-motor testing:—

The final temperature of a crane-motor depends—

(1) On the load (B.H.P.);

(2) On the load factor, $\frac{\text{time of working}}{\text{total period}}$.

With an ordinary machine for continuous rating we have only to consider two figures, viz., the load and the temperature rise. In the case of the crane machines a third is added, viz., the load factor. Having to deal with three figures, instead of asking, "What will be the final temperature at a given load and load factor?" we can reverse the question, and ask "For how many minutes out of 10 can the motor give a certain output, if the temperature rise is not to exceed 50° C.?"

The answer to the latter question can be very easily supplied by a test. When a crane motor has reached its final temperature, the temperature increase during the working period is exactly equal to the temperature drop during the stopping period. If, therefore, we take the temperature curve of the motor on full load, up to a little more than 50° C., or to 60° C., and carefully observe the time ($\tau w$) required for the rise from 40° to 60° C., then if we shut down the machine, and observe the time required for cooling down from 60° to 40° C. ($\tau s$), the load factor is given by the ratio—

$$\frac{\text{Heating time}}{\text{Heating + cooling time}} = \frac{\tau w}{\tau w + \tau s}.$$

It is very easy to take this test for all stationary parts to which a thermometer can be left attached during the working period. For the armature, one could stop, say, half an hour after starting, take the temperature at that moment (point 1, fig. 2), and easily judge in what time the 40° rise will be approximately reached. At the end of the period stop again, take the actual temperature, which need not necessarily be exactly 40° C. (point 2, fig. 2), run on again for

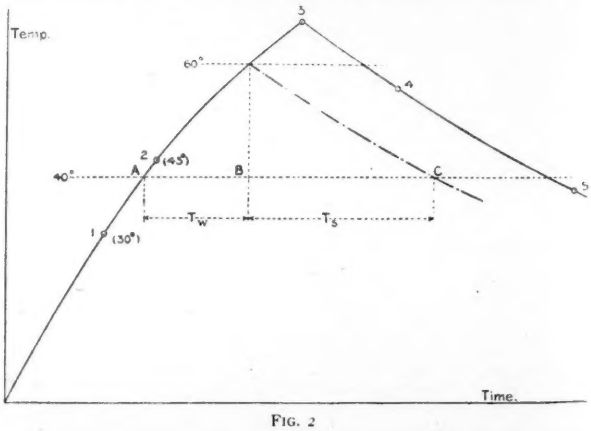



Fig. 2.

some time until 60° or a little more are reached (point 3, fig. 2), and then finally stop to observe the cooling of the armature (points 4 and 5). If point 3 does not coincide with 60° C., we transfer the cooling curve horizontally until it passes the 60° point (dotted curve, fig. 2), and draw the horizontal line A C through the 40° point, then $\frac{A B}{A C}$ is the load factor.

If the temperatures are taken with a thermometer, the latter should have a very small mercury bulb, so that it records the temperature of the armature as quickly as possible.

In these investigations I have preferred approximate methods to exact mathematical ones, the former enabling us to keep in closer touch with the real physical phenomena, and being more easily adaptable to any irregular case; on the other hand, they are precise enough for practical purposes. For investigations on a more mathematical basis, I refer to the excellent article of E. Olschläger, "On Intermittent Rating" (*Elektrotechnische Zeitschrift*, p. 1058, 1900).

Prof. S. P. Thompson, in opening the discussion, said that in reference to Mr. Rayner's paper, he looked forward to further contributions from the National Physical Laboratory. Mr. Goldschmidt's paper contained many valuable points, but many of his sentences were obscure, and in avoiding mathematical explanations he had loaded his paper with matter much harder to understand. Previous results had been obtained as to the heating of coils which did not tally with those given in the paper. He proceeded to point out discrepancies too numerous to mention, and concluded with a hope that for the sake of its valuable features the author would rectify those portions of the paper which were apparently deficient.

Mr. H. M. Hobart considered the latter paper the best that had been given on temperature rises from a practical designer. Mr. Rayner's paper was also a valuable contribution, although his own ideas of the testing of insulating material did not coincide exactly with the author's. According to Arnold, mica gave lower disruptive figures than the author's, and these lower figures were used by dynamo designers. He concluded by giving some interesting figures as to the relative cost of insulation in the several parts of a dynamo.

Mr. Walker explained, with the aid of the blackboard, the practical method adopted by the Westinghouse Co. in determining the temperature rises of new machines from the known characteristics of existing machines.

Mr. A. F. Berry said there was so much that was beautiful in the papers, that one had to dig for the useful matter. Two methods of treating insulating materials were available, either separately or as part of the conductor, and the method adopted depended on the type of insulation used. The tables, pages 5 to 15 of Mr. Rayner's paper, required very discreet reading, or they would be misleading. Cheap production was the interesting point to the manufacturer, and how to get a greater duty out of his materials. Overloading led to high temperatures, which had to be considered in practice. He commented on the varying results obtained with the several types of coil, pointing out that taping brought the maximum and mean temperatures nearer together. The fact that by partly destroying cotton we could improve its electrical insulation, was of great importance if people would only recognise it.

Mr. Russell considered that the results given in Mr. Rayner's paper showed how dangerous it was to fix a limit of temperature rise. The great object of the engineer was to obtain a larger output for the same amount of material, which could only be done by running at higher temperatures. He thought a temperature limit would restrict improvements in electrical machinery, and that there was a great deal in testing the insulations in contact with the conductor.

Mr Alex. Russell, commenting on the measurement of dielectric strength, said he thought that insulating material should be tested with the maximum electrical force to which the dielectric was subjected. He had come to the conclusion that thick samples required less breaking-down voltage per unit of thickness than thin samples.

Mr. Goldschmidt, in replying to the discussion, mentioned that it was easy to calculate to within a few degrees the temperature rise in field coils; he had noted a temperature 30° to 40° F. higher at the top of the field coils than at the bottom, owing the the accumulated hot air from the armature. He thanked Prof. Thompson for his more mathematical way of treating the results. He had adopted approximate methods as being more applicable to practice.

Mr. Rayner, in replying, pointed out that an iron core in a field coil did not promote greater cooling on the inside, as it got hot after the machine had been running some time. His paper dealt with low-pressure machines, where the disruptive voltage was of no importance, but where the brittleness of the insulating material was the limiting factor.

## PHYSICAL SOCIETY.

At the meeting held March 10th, Dr R. T. Glazebrook, Past-President, in the chair, a paper "On Direct Reading Resistance Thermometers, with a Note on Composite Thermocouples," was read by Mr. A. Campbell. The paper describes two methods by which the reading of a resistance box in connection with a platinum resistance thermometer gives directly the actual temperature without the use of any formula or table. In the first method the variable resistance in the measuring arm of the Wheatstone bridge is shunted by a suitable resistance. When this shunt has the proper value, the change of resistance in the measuring arm necessary to give a balance is proportional to the change of temperature of the platinum to a good degree of accuracy up to 1,000° C. A more exact method (that of the "Rectifying Loop") is somewhat similar. In it the measuring arm consists of a closed loop of resistance, one end of the arm being a fixed point on the loop, while the other end is a slide which can be moved along the loop. The total resistance of the arm is connected by a simple parabolic law with the excess x of the slider reading over a zero reading. Thus $R = A + Bx + Cx^2$. The author shows how the resistance of the loop and the zero reading may be calculated so as to make this parabolic formula identical with that giving the temperature resistance variation of any specimen of platinum. When the resistances have these values, the reading x will be proportional to the temperature (Centigrade) of the platinum.

In an appendix the author points out that for measuring small temperature differences up to 100° or 150°, the most useful thermocouples are iron-nickel or iron-constantan. The voltages given by these are nearly, but not quite, proportional to the differences of temperature. In order to make the proportionality more exact, he proposes to use a "composite" (triple) junction by putting in parallel with one of the usual wires a wire of a third metal (*e.g.*, copper); by adjusting the relative resistances of the branches of this parallel circuit, the temperature voltage curve of the combination can be practically rectified.

Mr. W. Duddell said that by putting a constant resistance in series with the rectifying loop, it would be possible to simplify the mathematical processes involved in the method.

Prof. Callendar thought the rectifying loop method of reducing the direct readings to the gas scale would be useful in practical work, especially at high temperatures, but for the most accurate scientific work at moderate temperatures the corrections would be too complicated, and trouble would be saved by adopting the ordinary method. It was most important in practice to secure accurate compensation of the leads, which could be ensured in a satisfactory manner only by making the leads and the ratio arms equal. Neither the loop method, nor the three-lead arrangement subsequently proposed by the author, could be used with a bridge-wire, as both involved plug or sliding contacts of negligible resistance. The three-lead arrangement also precluded the possibility of making an insulation test of the leads at any time. With regard to composite thermocouples, he did not think the arrangement would be useful except for very moderate ranges of temperature.

The Chairman pointed out that for the most accurate work it was advisable to work with the simplest possible form of apparatus and to apply the necessary corrections at the end. The constantan wires referred to by Mr. Campbell had been tested over a large range of temperature, and it had been found that a constantan-iron couple gave a linear formula.

Mr. Campbell, in reply, said it would be possible to arrange the rectifying loop with plug contacts instead of sliders; with 25 ohms in the measuring arm, sliders could not cause serious error. He had indicated clearly in the paper that when once the ratio of the resistances of the zero reading and the total loop (or the shunt) was found the absolute values of these resistances might be altered in any ratio desired. The bridge could thus have equal or unequal arms at will.

A paper "On the Stresses in the Earth's Crust before and after the Sinking of a Bore-hole," was read by Dr. Chree; and one "On the Lateral Vibration of Bars of Uniform and Varying Sectional Area" was read by Mr. J. Morrow.

## LEGAL.

Attorney-General and the Willesden Urban District Council *v.* The Metropolitan Electric Supply Co, Ltd.

The Lord Chief Justice and Lords Justices Vaughan-Williams and Stirling last week heard the defendants' appeal in this case from a judgement of Mr. Justice Farwell, who had granted an injunction restraining the defendants from supplying electrical energy for consumption or use within the urban district of Willesden otherwise than under the authority of Parliament, or under a license granted by the Board of Trade under the Electric Lighting Acts of 1882 and 1888, or from using any of their cables or wires for the transmission of electrical energy from their works at Willesden and Acton, except to their distributing stations in their Paddington, Marylebone and mid-London areas defined by the provisional orders in the Companies' Act of 1898, and the area in St. Martin's-in-the-Fields and the neighbourhood defined by the Metropolitan Electric Lighting Act, 1889. The defendants had supplied electricity to the North-Western Railway sidings at Brent, which were situated within the Willesden Urban District, and outside the authorised areas of supply of the appellant company. They refused to discontinue the supply, notwithstanding that the Council had on several occasions requested them to do so, and the railway company had declined to cease taking the supply until it was decided whether the appellants were entitled to give such a supply. The Supply Co. claimed that under their memorandum of association they had full and unrestricted powers of acquiring land, erecting electric works, and producing and supplying electric energy, and that such powers were aided in particular districts by auxiliary statutory facilities conferred by various Acts and provisional orders, but were not dependent thereon. They further submitted that the Acts relied on by the plaintiffs were passed with the intention and effect of giving in specified districts within the metropolis statutory facilities for supplying electric energy to various undertakers within such districts, and to prevent such undertakers from using the special statutory facilities in their own districts to enable them to compete with the similar undertakings created in adjoining districts under similar statutory facilities. They did not, however, limit the general powers of the defendants in the carrying on of their general business. The prohibition contained in the Act of 1889 was not a general prohibition, but only applied to the company as undertakers under the particular Act. Mr. Justice Farwell had agreed that the prohibition was not meant to extend to the company for all time, but he could not so interpret it as to limit it as the defendants wished. So long as they were undertakers working their particular undertaking under the Act, they must not supply electricity outside the statutory areas. They had obtained power

to erect a generating station outside the statutory area, but the Act clearly said that it was solely for the benefit of the customers of the company within the statutory areas. He could find nothing in the Act giving the defendants power to supply electricity in Willesden.

Mr. C. A. Cripps, K.C., Mr. Jenkins, K.C., and Mr. Sargant appeared for the appellants, and Mr. Upjohn, K.C., and Mr. Greig for the respondents.

Mr. Cripps argued that while under the Acts regulating the supply of electricity in the administrative county of London, the company was prohibited from supplying power outside its specified areas, there was no prohibition applying generally outside London.

At the conclusion of the arguments of Counsel for the appellants, and without calling upon Counsel for the respondents, the Lord Chief Justice, in giving judgement, said he was unable to see any flaw in the reasoning of Mr. Justice Farwell. He did not think that these Electrical Supply Acts could be considered independently of the general legislation on the subject. The main argument on behalf of the defendants, was that what they were doing was not done in the excuse of any authority given to them by Statute or the Board of Trade orders. It was said that they were a company incorporated under the Companies' Act of 1862, and that the exercise of their powers under that incorporation was not prohibited by anything contained in the Acts of 1889 and 1898. His Lordship was unable to take that view, or to give to Section 5 of the Act of 1889 any other construction than that which had been given to it by Mr. Justice Farwell. He agreed that the main object of the Act of 1889 was to provide for the metropolis—to carry out what was recognised as the best scheme for the administrative County of London. But he was unable to follow the argument that you were entitled to disregard the outlying areas. The words of Sec. 5 of the Act must be taken in their natural sense. He thought that, *primâ facie*, Sec. 5 meant that when the right to supply electricity was given to the company, one of the terms of the bargain was that they were not to supply electricity beyond the specified area otherwise than under the authority of Parliament or under a licence from the Board of Trade. He thought the company had bargained for limited rights upon the condition that they should not supply electricity outside their area. He could not find in the Act of 1898, anything which, by implication, negatived the prohibition in Sec. 5 of the Act of 1889.

The Lords Justices concurred, and the appeal was accordingly dismissed.

Mr. Cripps asked that the injunction might be suspended in view of the defendants wishing to appeal to the House of Lords.

Their Lordships granted a suspension, except in Willesden.

---

Blackpool Electric Tramways (South), Ltd., *v.* Electric Tramways Construction and Maintenance Co., Ltd.

This case came before Mr. Justice Warrington in the King's Bench Division on March 23rd. Mr. Fraser McLeod, for the plaintiffs, said it was an action against the defendant company and Mr. H. J. Lawson to recover £270. Judgement had been obtained under Order XIV. for the amount, but execution had been stayed pending trial of a counterclaim by the defendant company. Since then the defendant company had gone into liquidation, and an offer had been made by the plaintiffs and accepted by the liquidator that the parties should cry quits, plaintiffs making no further claim in respect of the judgement, and retaining the 35 preference and 62 ordinary shares in the Blackpool Co. which the defendants claimed. So far, therefore, as the company was concerned, proceedings would be stayed on the terms of that arrangement. He had no evidence to offer against Mr. Lawson, and that gentleman did not appear to ask for judgement, and the action as against him was therefore struck out.

---

A. H. Midwood & Co. *v.* The Lord Mayor and Corporation of Manchester.

(*Concluded from page* 481.)

At the resumed hearing on Tuesday, March 21st, Mr. Moulton, in opening the case for the defence, submitted that the plaintiffs had not shown that the Corporation had failed in any one particular in abiding by the directions of the General Acts, the Special Acts of the Board of Trade. The regulations of the Board of Trade were up to the very highest watermark of care, and he would show that everything that the Board of Trade required was attended to without negligence, and completely. Those were the points of law with which his Lordship would have to deal, but he would have gone a long way towards proving his case, if he showed that everything prudent men would do, had been carefully and thoroughly done by the Corporation. An electric supply without accident under any circumstances, was just as impossible as a supply of gas under all circumstances without accident. It was wholly impossible to supply such an immense area as Manchester without the possibility of accident, and he would submit that an inevitable accident which could not be foreseen or guarded against, did not make the Corporation liable. They were not insurers in that respect. The Corporation had done all that could be done to ensure a safe and certain supply of electricity according to their duties. They were bound to supply the entire area. To leave a part of the town in darkness, would be a breach of duty and a danger far greater than the remote danger of an accident such as had occurred in the present case. To suddenly stop the lights in a district, was not only to put the inhabitants to inconvenience, but to expose a great number of them to danger. When they came to examine the legislation on the point, they would find that the pressure in the mains must be maintained at a fixed level during the whole time the supply was going on; otherwise the supplying agency failed in its first duty, which was to continue the supply and lay down mains which would enable them to do so. The Corporation in this case did their duty in keeping up the pressure, as they were bound to do in accordance with their provisional order. As a rule it was perfectly safe, and under their system of working and construction, any risk there might be in supplying electricity was utterly minimised. The system adopted by the Corporation was not only the one adopted by the Board of Trade, but it was the best one. This case was an attack on a system which was practically universally used throughout this country, and he thought he was entitled to complain that such an attack should have been made without warning. It must have astonished every electrician who had read of it, and he could quite understand why the plaintiffs had only called an electrician in the employ of insurance companies. He had never heard of a big city which was not connected up practically all over. The great object was to secure uniformity of pressure. He could not help thinking that the description given of the Liverpool system was a great exaggeration. If it were true, then Liverpool must have gone back to the dark ages. The alternative system suggested would be wholly useless for any large town. Manchester had 500,000 lights on its system, and its record was an extraordinarily good one if the trifling accidents, with respect to which evidence was given the previous day, were the only ones that could be put forward. The present system was the best system, it was carefully laid, and had always been in the hands of skilled men. The consequence was that although it had not been free from accident any more than railway systems were, it certainly could not have been doing its work very badly, or there would have been a much more serious tale of disasters. With regard to the fire on the plaintiffs' premises, he would show that the Corporation did everything that could be done immediately the leakage was detected.

Mr. Stanley L. Pearce, chief electrical engineer to the Manchester Corporation, said that the Corporation supplied electricity for lighting, power and tramway purposes The necessary power to maintain this supply was:—Dickinson St., 15,000 H.P.; Bloom St., 14,000 H.P.; and Stuart Street, 15,000 H.P. In the case of a defect, it was possible to sub divide the area down to the length of one street supplied by one feeder only. In his opinion the system was a good one. It was approved for Manchester by the Board of Trade, who had inspected it from time to time. It was laid by Mr. Wordingham, who was now with the Admiralty. A fault was usually detected by irregularity in the lighting on a consumer's premises, or by smoke or smell percolating through the pavement. He had known it take three days to localise a fault by the process of division.

Cross-examined: In order to remedy a defect the central, north and south-eastern districts would have to be separated. It would take a considerable time to effect the severance. When any mischief was discovered the mains engineer would be called on to disconnect the districts. The mains engineer would not be in attendance at the generating station between the middle of the day on Saturday and Monday morning, but he could be summoned by telephone.

Do you say that under the Manchester system nothing could be done for three hours to localise the mischief in Fountain Street?—Everything was done that could be done under the circumstances.

What was done?—The south-eastern district was cut off, then the central was isolated from the northern about 3.30.

Is there any record of that division having been made?—No, it is not usual to record it.

Further cross-examined: He recalled an explosion which occurred on April 15th, 1904, at the corner of Jackson's Row and South Street, owing to the fusing of the cables. He did not recollect a fire at Marsh's restaurant in Peter Street, due to the fusing of a cable. It was the common custom of the Manchester papers, as it was of all daily papers over the country, to attribute all fires that could not be accounted for to the electric cables.

On Thursday, March 23rd, Mr. Alfred Clough, the engineer in charge of the electrical system of the Liverpool Corporation, was called to give evidence with respect to the statement made that the system in Liverpool was to divide the area into districts of 1,000 lamps, each district being connected with the generating station by a separate feeder, and disconnected from all other districts. Witness stated that this was only correct as far as the outer area was concerned. The reason they had small circuits in the outlying area, was because they were connected with small generating stations. They had five generating stations connected with refuse destructors. Under the Liverpool system it might take several days to localise a small defect, and three or four hours if it was a very large one.

In examination, Witness said that instead of being linked up like Manchester, they had 100 different circuits with separate feeders. They had not been free from accidents, but had not had many serious ones.

Mr. J. Swinburne, the well-known consulting electrical engineer, said he had inspected the system of electrical distribution in Manchester. It was in accordance with the Board of Trade regulations, and up to the best modern electrical knowledge. The only thing in the least peculiar about the Manchester system was the use of the five-wire instead of the three-wire system. Everything else was standard. With respect to the Fountain Street trouble, the recorder did not indicate any really serious disturbance until well after 1.30 a.m. The steps taken by Mr. Howard were the proper steps in the circumstances.

Cross-examined, Witness said that in Manchester they did what they could to localise a fault.

In re-examination, Witness said the linked system was practically universally adopted, because it was the best. The important point was not the localising of faults, but the maintenance of uniform

pressure. The system adopted by Manchester was the best, according to the electrical knowledge of the day.

This concluded the evidence, and counsel addressed the jury.

Sir E. Clarke, K.C., read the reports of 20 accidents which had occurred in connection with the Manchester electrical system in three years, and expressed the hope that this case would secure that, whenever an accident occurred in future by which private persons were endangered, they would be compensated.

His Lordship, in summing-up, said it was no answer to the charge of creating a nuisance to say that you had not been negligent. On the question of negligence, the jury would have to say whether the defendants took reasonable steps to avert the risk of fire.

The jury found that the system adopted by the defendants constituted a nuisance, by causing danger to persons having premises adjacent to the mains, that they were guilty of negligence in adopting their method of localising and dealing with the fault, and that when they became aware of the fault they did not deal with it for the purpose of preventing fire in a reasonable and proper manner.

On this, his Lordship entered judgement for the plaintiffs for the agreed sum of £677 7s. 4d. with costs.

---

### Galbraith *v.* Hadfield's Steel Foundry Co.

At Leeds, last week, before Mr. Justice Ridley and a special jury, this case was heard. For the following report we are indebted to the *Times*.

This was an action for wrongful dismissal. Mr. Tindal-Atkinson, K.C., and Mr. Compston appeared for the plaintiff; Mr. Scott-Fox, K.C., and Mr. Waddy for the defendants.

The defendants are steel-casting manufacturers, of Sheffield. In 1889, the plaintiff, Mr. David Galbraith, had been appointed secretary to the company, and in May, 1903, he was made their London manager. His salary was fixed at £475 a year; but it was understood that if the London business advanced satisfactorily this was to be increased, and at the time of the alleged wrongful dismissal the plaintiff was being paid a salary of £1,000 a year, besides a commission of 1 per cent. on all goods sold by the London house not manufactured by the company. The London business had largely increased under the plaintiff's management, and the turnover, which was £15,000 in 1893, had risen to £160,000 in 1904. The plaintiff had latterly complained several times that the conduct of his business was interfered with by subordinates from Sheffield, who were sent, without his knowledge, to interview London customers; and it was alleged by the plaintiff (though denied by Mr. Hadfield for the defendants) that a definite assurance had been given that such interference should not take place. In July, 1904, complaints were received from the Lisbon Tramway Co., Ltd., one of the London customers of the company, about certain goods which had been supplied to them. The company sent a man called Pickering to go with the plaintiff to interview the Lisbon company's agent, the alleged reason for sending him being that he had packed the goods and had special technical knowledge of their construction. The plaintiff refused to go with Pickering in spite of orders by telegram from Sheffield to do so. On being remonstrated with for this he expressed his feelings strongly, and gave, in accordance with the terms of his agreement of service, three months' notice. Subsequently, on August 8th, at an interview held at Sheffield between the plaintiff and the company's directors, the plaintiff announced his intention of invariably declining to obey such orders, and was thereupon summarily dismissed. The defendants relied on the above facts to show that they were entitled to dismiss the plaintiff, who claimed three months' remuneration in lieu of notice. The defendants also counterclaimed for an injunction restraining the plaintiff from obtaining, within two years, employment in any other steel-casting firm.

The jury found a verdict for the plaintiff; damages, £301 18s. 4d. Judgement was given for the plaintiff on the claim and counterclaim, with costs.

---

## THE HOLBORN AND FINSBURY ELECTRICAL EXHIBITION.

(*Concluded from page* 512.)

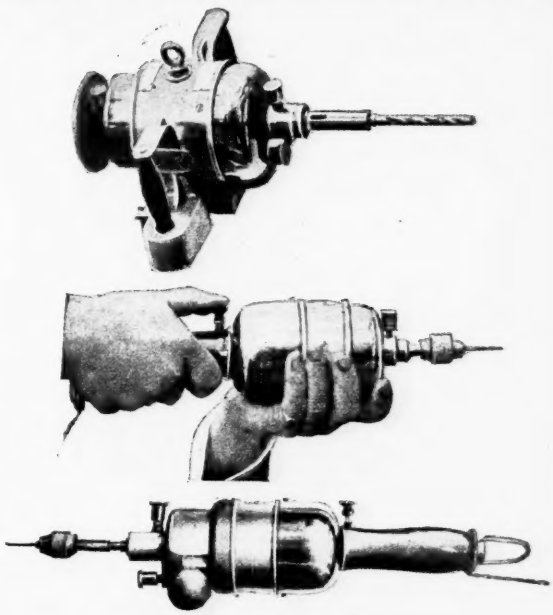
Among the more novel exhibits, we noted at Messrs. Monté-Callow's stand their new "Emsea" motor-starter, for which they claim both correct design and low cost.

In this starter the handle of the switch is connected to the arm carrying the brushes, through the no-load release, thus preventing the switch-arm being moved until the magnets of the motor are excited, keeping the no-load release and the overload release, if this is used, continually in operation during the process of switching on.

The use of the overload release prevents the motor being started too rapidly, as too great a rise of current at once switches off the motor, and this, combined with the resistances being so constructed as to prevent the current from rising by steps exceeding 10 amperes right up to 50 per cent. overload, renders the use of separate slow motion gears unnecessary. Separate mechanical release triggers are provided for switching off. When desired, Atkinson's overload release is attached to the switch on a special cast-iron bracket bolted to the frame. This release consists of an ammeter fitted with automatic gear for short-circuiting the no-load release. In the event of overloads exceeding, say, 100 per cent., the release operates at once, but for overloads of smaller amount a time lag is introduced. Thus the release can be adjusted to allow of 25 per cent. overload for, say, 15 minutes, or 50 per cent. for 5 minutes, the time lag being adjustable. This allows of the motor being started under an overload of considerable amount without the risk of its being permanently overloaded.

We hope to illustrate and describe this apparatus more fully at an early date.

Messrs. Durtnall & Pries, of 75, City Road, E.C., show a selection of portable electric drilling machines, which we illustrate below. These tools are light in weight, and easily manipulated; they are



Portable Electric Drills.

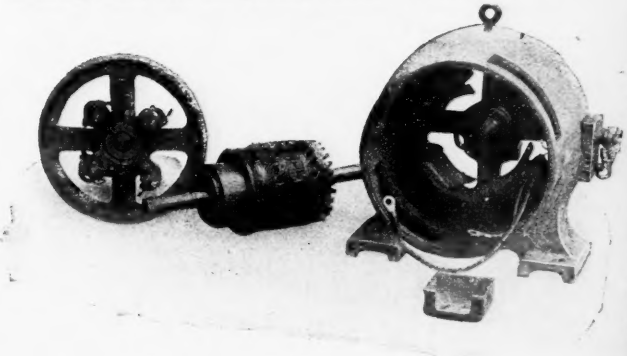
built for standard pressures of 110, 220, 440 and 500 volts, and provided with a suitable adaptor and flexible, for connecting to any existing electrical fitting. The firm supplies three types of this drill, namely, the "S. B." for drilling up to ¼ in., the "H. K." for up to ⅜ in., and "H. G." for up to 1¼ in. diameter holes.

The former type is constructed with or without reduction gear, and the speeds range from 250 to 3,000 r.p.m. The control is in the form of a press button, which is also provided with a bayonet lock in case it is desired to keep the drill running, without attention to the button. The two latter types of drill are geared, and have a speed range of from 60 to 600 r.p.m.

In the case of the H K. type, the control is in the right handle, and either two or four speeds are provided. The speed regulation is obtained by means of a series-parallel connection of the field winding, and by altering the gear ratio. An ingenious electric alarm bell is attached, which gives certain warning should the drill be overloaded. In the left handle a switch is provided for reversing purposes, and, if required, the machine can be attached to a bench drill for workshop use.

These drills are exceedingly light in weight, ranging from 5¾ lb. in the case of the "S.B." to 12 lb. for the "H.K." type. The drill cases are made of aluminium alloy, giving both mechanical strength and lightness; the case is easily removeable for the purpose of inspecting the internal mechanism, and the spindles are fitted with a suitable cone for attaching ordinary almond drill chucks.

The Morris-Hawkins Electric Co., who specialise in electric motors, provide an exhibit of motor-driven machinery, the latter including bread, boot and printing machines. This firm is now



Morris-Hawkins Motor.

building standard machines in sizes ranging from 1 to 50 B.H.P., the type and construction of which will be gathered from our illustration.

## THE PADDINGTON ELECTRICAL EXHIBITION.

That electrical exhibitions are becoming recognised as necessary for the enlightening of a conservative (or ignorant) public, can hardly be doubted, from the frequency with which they are occurring.

We have now to record the opening, on Saturday last, of the Paddington Electrical Exhibition, organised by the Metropolitan Electrical Supply Co., Ltd., the statutory suppliers of electrical energy in that borough. Although not on such an ambitious scale as its contemporary show, referred to on the preceding page, it is yet a useful display of the many and varied uses for which electricity has been adopted in modern times.

The exhibition was opened by Alderman W. Urquhart, Mayor of Paddington, and subsequently a luncheon was held, presided over by Mr. F. Leverton Harris, M.P., the guests including Sir Melville Beachcroft, Mr. J. Carr Saunders, Mr. Northcote (Veritys, Ltd.), Mr. E. Cunliffe Owen, the Mayors of Holborn and Paddington, and many other gentlemen.

The exhibits are tastefully displayed on some 40 stands, the firms including Messrs. Veritys, Ltd., with a selection of dynamos, motors, arc lamps, fittings, &c.; Messrs. Rashleigh Phipps & Co., who have specialised in electrical cooking and heating apparatus, to an extent which is certainly not realised by the average individual; the Dowsing Radiant Heat Co., Ltd., who provide a comprehensive display of electro-medical appliances on their well-known system; the Hardy Patent Pick Co., who show a magnetic separator of the type adopted by the Fulham and Stepney destructor authorities, and others. The British Westinghouse Co. exhibit motors, switchgear, instruments, &c., and a Cooper-Hewitt mercury vapour lamp. The Westminster Engineering Co. show a Thomson electrical welder at work, and Messrs. Langdon-Davies, the Crypto Electrical Co., and Sir Hiram Maxim Electrical Manufacturing Co. are also represented. The excellent display of modern electrical fittings which is to be seen at the stands of Messrs. J. S Henry, Ltd., and Ivor Blaiberg & Co. demonstrates the artistic possibilities of wood in this direction.

Messrs. Babcock & Wilcox, Ltd., occupy considerable space with coal-conveying plant, &c.; the Metropolitan Electric Supply Co. show motor-driven machinery, and the National Telephone Co. also contributes a useful selection of their specialities.

The exhibition remains open until April 8th, the musical propensities of visitors being catered for by the Grenadiers' band during that period.

## CORRESPONDENCE.

*Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### A.C. v. D.C.

In company with my colleagues, I have heartily enjoyed Mr. T. Wheeler's attempted little jest at the expense of such D.C. men as might prove susceptible. At the same time, the grain of sense amongst the chaff is noticeable, namely, the fact expressed that "a man conversant practically with an alternating current system is qualified to take charge of direct current plant." Granted this is true, Mr. Wheeler overlooks the fact that the converse is equally true, and more so (excuse the Hibernicism) if there is any reason in the only argument advanced for the original proposition, "that the greater includes the less;" for it is generally known that a direct-current dynamo or motor is an alternator, plus a commutator; in other words, the direct current is the greater, and includes the alternating current as the less. In conclusion, if Mr. Wheeler, or anyone else, wishes seriously to contend that alternating current experience is a higher grade than that of direct current, then he must support his contention by naming some operation which has to be performed by a man on an A.C. system, which is beyond the capability of a man similarly qualified in D.C. supply. When this occurs, there may be something to be done by the "batteries" of

D.C.

### Localisation of Faults in Cables.

I regret that a mistake, due to my own carelessness, should have been made in the result of the example given in my previous letter; this should be 320 yd. instead of 302 nearly.

With reference to the "Writer of the Article's" letter in your paper of 24th inst., I may state that it is quite possible to apply the test for a short circuit between two conductors of a triple-core or three-core cable by using the remaining conductor (which need not have a high insulation resistance) for the test wire, and by taking the testing current from the live mains at the disconnecting boxes, or from portable accumulators, whichever may be most convenient.

In reply to "W. H. R.'s" letter, I may state that I have never found it necessary to make the connection he recommends when testing for earths, as I seldom use a testing current exceeding 5 amperes, even for short lengths of ·25 distributors between disconnecting boxes on opposite sides of a road; but when testing for short circuits between two conductors that are not earthed, it is, of course, necessary to connect one of the faulty conductors to the neutral wire.

"J. W." in his letter states that your correspondent neglects the resistance of the lead sheathing and the paths through earth in his test; this is not so, as he assumes them to be proportional on each side of the fault, but this assumption cannot always be relied upon.

I shall be pleased if you will allow me to modify the first part of my letter in your issue of 17th inst. I can only recommend the testing current (for your correspondent's method) to be taken from the live main in the disconnecting boxes for short circuits between conductors, and not for earths; in the latter case a secondary battery is to be preferred, as the whole of the return current would then travel back by the lead or adjacent earth, whereas if a testing current were taken from the supply mains with one of the poles earthed at the station, or accidentally elsewhere, the testing current, or part of it, would return to this earth, probably in one direction along the lead of the cable from the fault, and thus make the results still more unreliable.

B. S. H.

### A Problem.

Would you be good enough to answer this problem? So many engineers differ—consequently I am anxious to hear your opinion:—

We generate (three-phase, 25 ~) at 2,200 volts, and send up 200 KW. 1 mile at 2½ per cent. drop. If we double the voltage and make it 4,400, what shall be the additional H.P. delivered at the other end?

J. W. M.

[*Answer.*—600 KW., or about 800 H P., with the same percentage drop. The "engineers" who differ on this point must have mistaken their vocation.—Eds. E.R.]

### Differentially-wound Rotaries.

I noticed in your paper a few months ago an illustrated description of the electrification of a railway in France. In the description, it was mentioned that the sub-stations were equipped with *compound* wound rotary converters having the series turns on the field *opposing* the shunt turns. It was stated that these worked quite satisfactorily. Could you, or any of your correspondents, explain how such rotaries work, as I fail to see how they can do so with the series opposing the shunt.

G. J. R.

[The reversed winding gives a rapidly falling pressure with increase of load, a condition which is essential to enable a battery floating on the line to equalise the load on the generating plant. The pressure regulation is, of course, very bad, and it is much better to use an automatic reversible booster.—Eds. E.R.]

### Public Protection and Overhead "Live" Wires.

Your issue of March 10th contained a contribution regarding the recent remarkable case of Neale *v.* East Ham U.D.C., in which the plaintiff, struck on the head by a "live" wire while on a tramcar, sought compensation, and a verdict was given for defendants with costs. So far doubly unfortunate, plaintiff seems to have been considered an easy prey for your contributor to dance upon while down.

I ask you, in justice to the public, and in the interests of true electrical progress, if not also in fairness to the plaintiff, to insert the following by way of correction, though I know nothing whatever of either of the parties, or their previous history, and though one impugned that of the other and so imported prejudice into the case, which we may consider

without it and without considering the measure of the damages plaintiff ought to have been awarded.

Plaintiff proved his case by three independent eye-witnesses' evidence. Defendants put in their interested servants' irrelevant evidence and experts' irrelevant opinions, plus prejudice. The verdict was obviously and absolutely against the weight of evidence.

Plaintiff claimed that the defendants were bound to provide for his safety against falling wire, &c., while on their car as passenger, and that they had neglected to do so, though they might have done so by a roof or cover to the car, and admittedly had not. The judge ruled that "if there was a fault in the overhead wire which it was impossible for defendants to find out, that would discharge them from negligence." So directed, and having also been prejudiced, the jury erred.

That direction might have been relevant in the case of a non-passenger, but it is manifestly irrelevant and not justly or legally applicable in this case of a passenger; and even if it had been applicable in this case, it was not proved by defendants that an undiscoverable fault existed in the wire, but the defendants' most experienced servant was alleged to have thrown away, after the accident, the broken piece of wire, which, if verified, might have proved such externally undiscoverable fault (if any), and the allegation was not denied.

No appeal or application for new trial appears to have been made, doubtless because the plaintiff is, or will be, ruined by the crushing weight of the costs he is loaded with. But this decision is of immense importance to the public and to all true friends of electrical progress. It involves a most serious miscarriage of justice and is contrary to all sound public policy.

W. H. Sharp.

Manor Park, *March 28th*, 1905.

---

### Earthing, and Conduit v. Casing.

I have read the letters which have appeared on the subject of earthing in your columns during the past three weeks, and will endeavour to briefly answer your correspondents.

The earthing of metal conduits buried in plaster or concrete cannot be relied upon, and the sheathing should be earthed quite independent of this. I think your correspondent "B" will find that if he passes a current of even one ampere through damp plaster, very soon a film will be formed around the conduit, and the current will gradually die away. This has been my experience with lead-covered cables in clay and damp earth. The earth afforded by stone work, also, cannot be relied upon; it is very likely to dry up and form a high resistance.

My paper was not intended to be a condemnation of metal sheathed systems, but the facts therein brought together may act as a warning to metal conduit enthusiasts, that metal piping is not to be slung up anyhow and everywhere.

Of the 15 fires that I mentioned as having occurred on metal sheathed installations, 10 were in cases where the insulated conductors were enclosed in iron pipes, and the other five took place with lead-covered cables.

W. W. Lackie.

---

### Petrol v. Electric Tramways.

It was with no intention of appearing as a partisan of the petrol as against the electric tramway that I asked your permission to be heard on the subject, and I have no desire now to over-estimate the powers of the petrol as against the electric motor. As you frankly state, however, in your REVIEW of March 24th, "There is a field for which petrol cars are particularly suitable," and it was rather with the feeling that this "field" had not been hitherto recognised that the letter you refer to was written. There was no need to define the uses and advantages of the electric tramway, as these have all been more than fully overstated by many advocates who have often thought it necessary to belittle any system which seemed to compete with it. It is with pleasure, however, that a fair critic must be acknowledged, although there may still be points on which differences remain.

The fact that the Perth rails were out of gauge is not disputed. It will no doubt be further conceded that the car could not be tested until the rails were put into proper order. The conclusion, therefore, was fully justified that "the Perth car never had a chance of demonstrating what could be done." The next point was that the car climbed the steepest gradient (1 in 12 it is said) with more than the full load agreed on. This again is not disputed.

It may be that the tracks should have been fully relaid, but this was not proved to be necessary, and many a good track, although primarily laid for horse traction, might be quite well used for mechanical traction without total reconstruction.

It was never suggested that a horse car, loaded even over its full capacity, weighed 9 tons. The new petrol-car, which was of 3 ft. 6 in. gauge, weighed 4 tons 5 cwt. empty, and, loaded with 50 passengers, would be about 7½ tons. It was, therefore, quite a fair deduction that a petrol-car of ordinary gauge would not weigh more than 9 tons—in fact, this was the calculated weight taken from the experience of the car already built and using a heavier engine, owing to the increased weight.

It was also freely admitted that several alterations were contemplated in the construction of another car, just as many improvements are suggested in all new experimental work after the first experience; but, had the condition of the rails admitted of the running of the car, the further experience would have been most useful, and the results in the builders' opinion would have been satisfactory.

If it were required to follow up the question of the weight of a horse car, it may be mentioned that one to accommodate 42 passengers weighed 2 tons 19 cwts. empty; or loaded, 5 tons 10 cwts. It was, however, not uncommon for the horse cars on the Perth route to leave the rails, but, as has been pointed out in the article now under discussion, horses draw the cars on to the rails quite naturaliy, whereas motors applied to the axles have sometimes a greater tendency to push the cars off the rails.

In the matter of the working costs of the electric system, the expenses of the power stations which are not exclusively used for traction purposes are so much mixed up with the supply of electric energy for other objects, that it is really difficult to get at the actual cost for purely tramway work. As a rule, the tramway is charged about half the public rate, and the profit on the quantity sold to the public is more than enough to cover any loss which may arise from the low rate charged to the tramway, even if there should be any such loss. There can be no injustice, therefore, in charging a value of an installation which would be proportionate to the amount of energy required for tramway purposes, as in this way they can better be compared with the many tramway systems which have a special installation for their own use. The comparison of the capital of various towns or of the two systems now being discussed could not otherwise be made.

The extraordinary electric current required to start a tram-car, especially if working upwards on a gradient, is not a new discovery, but it should not be expressed as horse-power, because as soon as motion is imparted to the car the great strain is relieved, and the pressure falls. Electrical engineers have elected to use this extra current instead of using multiplying gear, as they have so much power to spare that economy is no object. On the other hand, however, the petrol engine working with less power at starting, uses the low-speed gears and accomplishes the rapid acceleration of the car in a different way. The electric energy is applied more in the method of the hydraulic crane, the power of the petrol engine is more after the manner of a steam crane, but neither of these are exact similes.

On the question of costs, there are very considerable differences. The capital outlay which has been submitted, was from actual cost as shown in the returns published:—Glasgow tramways cost £18,182 per mile; Leeds, £13,584 per mile; Sheffield, £16,610 per mile; Nottingham, £22,372 per mile; and it was not inappropriate to charge London £18,000 per mile. In fact, if it had been sought to compare the figures with the electric conduit system of London, the cost per mile would have been nearly £26,000.

I know of no electric tramway which has been carried out

in the kingdom at a cost of £9,800 per mile, although this sum appears to be suggested as sufficient.

Taking then the actual cost from the best ascertained figures which we have, and conceding the 10 per cent. for interest, maintenance and depreciation, instead of 11 per cent. as before, the result will be 3·29d. per car-mile, instead of 3·62d. as formerly stated. The expenses of working at 5d. are admitted.

With regard to the expense of renewals and repairs, the following accounts may be quoted. These are the extra costs paid for working and renewals beyond the 5d. per car-mile already allowed :—Glasgow, 2·40d.; Leeds, 1·60d.; Sheffield, 2·03d.; Dundee, 2·79d.; Halifax, 4·05d.; Nottingham, 2·86d.; and the amount should not, therefore, be put at less than what has been previously put down, viz., 2½d. per car-mile. This makes in all 3¼d. + 5d. + 2½d. = 10¾d. per car-mile, instead of 11½d., as previously stated. It is doubtful, however, if this smaller amount will be sufficient.

Turning now to the question of the cost of the line to be worked by the petrol tramcar :—

In the reconstruction of the track there is no difference per mile—£6,000.

Seeing the cars were smaller, and some extra cars might be required at the "crush" hours, five cars per mile were taken instead of four. These, however, only cost £1,000, and contain 50 passengers = per mile £5,000. It is quite expected that the price of £5,000 per mile will include car-sheds and sundries, but, conceding £400 per mile in addition, as suggested, the total cost per mile would be £11,400, which at 10 per cent. as before = 2·08d. per car-mile. With all due deference to the opinion expressed on the other side, there is really no advantage gained by the larger car, as, for at least 12 hours in the day, the smaller car is quite sufficient. The extra cars which have been allowed for will take the additional passengers in the event of a crush.

The working costs are retained at 5d. by agreement. In the last item the question is narrowed down to the maintenance and renewals of the cars, the maintenance of the permanent way having already been allowed for. Taking 20 per cent. of the value of the cars—

$$= \frac{£1{,}000}{365 \text{ days} \times 360 \text{ miles}} = \cdot 76\text{d. per car-mile.}$$

Summing up, we have 2·08d. + 5·00d. + ·76d. = 7·84d. per car-mile. It is thus found that if the figures are worked out very closely the original amount of saving has not been exaggerated.

I must apologise for occupying so much space. It has not been possible to touch upon the other points of comparison or difference between the two systems, and I can only hope that the estimates given have been fair and evenly balanced.

**Motor-Tram.**

*March 27th*, 1905.

P.S.—I am sorry to have omitted answering a letter in this week's issue on the same subject by a correspondent, but I shall be pleased to revert to the subject shortly on another occasion, with the Editors' permission.

[Our correspondent appears to be unaware of the fact that in the majority of cases where lighting and traction are supplied from a joint station, the loss on the lighting is made good by the profits on traction, and not *vice versâ*; the relative quantities of energy supplied for lighting and traction afford no criterion whatever as to the capital outlay on behalf of the latter. As to the cost of construction, "Motor-Tram" has apparently taken the cost per mile of double track instead of single track; this is the only way in which we can account for the absurd figures which he quotes. We adhere to the statements contained in our article of last week.—Eds. E.R.]

### Publication of Prices Tendered.

Would it not be of interest to a large number of firms in the trade, and more especially to those who do the estimating for these firms, if there were a page in your valuable paper devoted to contracts closed, in which not only the name of the successful tenderer should be given, but the amount at which he obtained the tender, and also as far as possible the prices given in by the unsuccessful candidates?

In other trades this seems to be the rule, and we do not think that any firm of good standing would object to their price being published. It may be said that the publication of these results would not be of much use, but if you will look at it from the point of view of the man who gets out the estimate, you will see that it is rather an unsatisfactory ending to a week's labour to have a curt note from the town clerk, or other authority, stating that "I regret that your tender has not been successful."

We shall no doubt see from the attitude of other readers whether this idea would not be of general interest.

**Manufacturers.**

[We have long made a practice of publishing the details mentioned by "Manufacturers," whenever they are obtainable, but sometimes consulting engineers and purchasing authorities are very careful to keep the lists to themselves as far as possible. In some instances, too, tenderers themselves have been known to object to the publication of their detailed prices. These and other difficulties stand in the way of our correspondent's proposal; but we shall be pleased to have our readers' views on this matter.—Eds. E.R.]

## THE TELEGRAPHONE IMPROVED.

In our issues of April 27th and October 12th, 1900, and May 10th, 1901, we gave particulars and illustrations of the Telegraphone invented by Waldemar Poulsen, a Danish electrical engineer. In the latter year the apparatus was exhibited in London, but since then little has been heard of it. Now, however, it has again been brought forward, in a greatly improved form, as shown in the accompanying illustration, and on Tuesday last we had the pleasure of seeing it and testing its capabilities.

The apparatus in its present form comprises two drums, on which the steel wire is wound; the recording, reproducing and obliterating magnetic system between the drums; and a hollow base, in which are contained the driving motor, starting, stopping and reversing gear, &c. The wire is of pianoforte steel, ·25 mm. in diameter (No. 33 S.W.G.), and is 5·4 km., or 3½ miles, in length; the wire is wound off at the rate of 3 m. per second, and thus suffices for half-an-hour's continuous running, equivalent to 3,000 words, at the rate of 100 words per minute, or nearly four of these columns. A press-button switch accompanies the apparatus, having one button each for Forward, Backward and Stop. The magnetic system is carried on a pillar, which moves to and fro as the wire runs through, so as to lay the wire evenly on the drums.

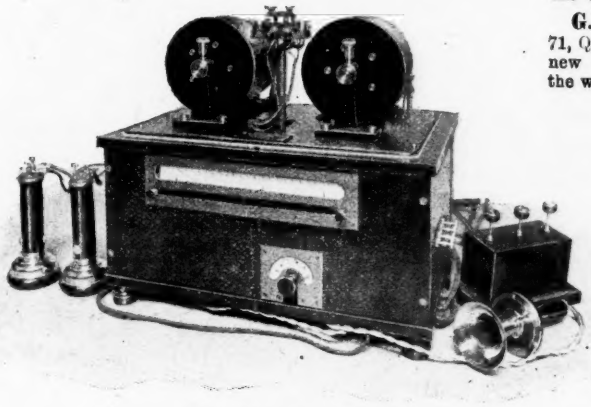
In the base there is an indicator, which shows how much of the wire has been used, and how much remains unused; this is provided also with two pointers, which can be set anywhere, so as to mark off a given portion of the wire. A dial-switch is also provided, which, in the case of the dictation Telegraphone, gives three positions—Dictation, Hearing and Secretary—in each direction of rotation. When the switch is set at Dictation, the user can speak into a microphone transmitter, and dictate correspondence, speeches, &c., which can afterwards be repeated to the speaker by setting the switch to Hearing. To prevent the superposition of one speech upon another, the Dictation connection always brings into action an obliterating magnet, which wipes out all previous records. A polarising magnet is also provided, to give an initial polarisation to the wire, which greatly increases the sensibility of the apparatus.

On setting the switch to Secretary, the apparatus comes under the control of an amanuensis, who may be situated in another room at any distance, and is provided with a switch-box similar to that of the owner. The secretary presses the Forward button to start the instrument, and having listened to a sentence, presses the Stop button and proceeds to write, or type-write, the matter. There is a noteworthy point, however, in the action of the secretary's stop-button; when

this is pressed the machine not only stops, but *runs back* a sufficient distance to ensure that, on restarting the machine, the last few words will be repeated, so that none may be omitted. Should the secretary desire to compare the written copy with the record of the Telegraphone, he presses the Backward button and runs the machine back until the beginning of the record is reached, after which the speech or passage can be quickly compared with the original. All this we personally put to the test with satisfactory results.

Should anyone, by chance, omit to stop the machine, it runs on to the end of its range and then stops automatically, without injury. There is no need to run all the wire back before starting a speech, as the instrument can be used running in either direction. The records are permanent, even if the wire is allowed to rust; a brief speech uttered by the King, at Copenhagen last year, expressing his interest in the machine, has been repeated thousands of times, but we heard it distinctly.

The foregoing description applies to the ordinary office instrument; but there is an important field of application



The Telegraphone.

open to the Telegraphone, as a recorder of telephonic conversations. We held a conversation with another office whilst one of these instruments was connected with the telephone; the speeches of both parties were faithfully recorded. The importance of this application needs no demonstration. It will be noted that the conversation is recorded by electrical means, and is not in the least dependent upon sound waves reaching the instrument, which may be in a room 100 ft. from the telephone. Again, the Telegraphone may be left connected with the telephone when the office is closed; when a call is received, the machine automatically starts and runs for two minutes, during which interval a message may be recorded, which the owner of the office receives upon his return. As the range of the instrument is half an hour, obviously 15 such messages can be stored up in the owner's absence. These functions can be combined with those of the dictation instrument, but the apparatus then acquires an undesirable complexity, and it is preferred to keep them separate.

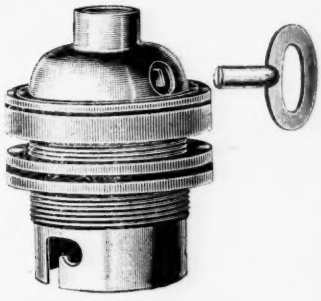
A neat little machine is also made, in which a steel disk, driven by clockwork, is used in conjunction with a recording magnet which is guided so as to trace a spiral path on the disk, just as in the gramophone. Both sides of the disk can be used, giving a time range of 2½ to 3 minutes, and the disk can be sent by post to a correspondent equipped with a similar machine. The speed of the disk increases as the "stylus" approaches the centre, so as to maintain the linear velocity constant relatively to the "stylus." This machine can, of course, be used for dictation, like the other, but its range is short, and its convenience restricted. We may mention also the multiplier, which consists of an endless steel ribbon, which passes over a transmitter, any number of receivers, and an obliterating magnet. With this instrument, which has been previously described in the Electrical Review, a spoken message may be repeated to any number of persons situated at different stations. But space forbids further detail; we will only add that a visit to the office of the Telegraphone, at 28-29, St. Swithin's Lane, will be amply repaid by the pleasure derivable from examining this remarkable machine.

## BUSINESS NOTES.

**Staff Dinner.**—The annual staff dinner of the General Electric Co., Ltd., (Witton Branch) was held at the Grand Hotel on Saturday, the 18th inst., and was a great success, about 115 being present. The chair was taken by the local director, Mr. M. Railing. Dr. Sumpner, the Principal of the Birmingham Technical School, and various local celebrities, graced the board. The toast of "The King" having been honoured, Mr. Railing proposed "The Staff," and Mr. Dumas responded; "The Directors," by Mr. E. Wilson, and "The Visitors," Mr. McLagan, were duly responded to by Mr. Cheesewright and Dr. Sumpner, and were heartily received. Mr. Hirst, the managing director from London, was also present, and gave a few words of kindly advice to the staff. The evening was completed by a musical programme, rendered by members of the staff and works, assisted by the works' own "Witton" orchestral band.

**C.C. Brand Paints.**—Sample tins of acid-resisting enamel and metallic paint have come to hand from the C.C. Brand Paint Co., of 82, Victoria Street, London. The former appears to be a kind of spirit varnish; it sets in a few minutes, taking a glossy surface, and resists sulphurous fumes, dilute acids, boiling water, &c. The metallic paint forms a bright metallic surface, like that of aluminium, is proof against heat up to 500° F., and is applied in one coat only.

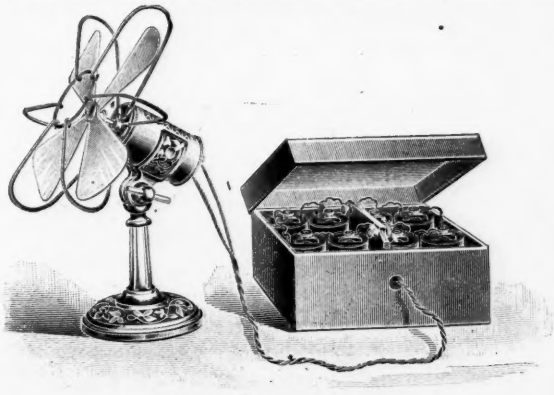
**G.E.C. New Lines.**—The General Electric Co., Ltd., 71, Queen Victoria Street, E.C., has just placed on the market a new lampholder fitted with a locking device designed to prevent the withdrawal of lamps by unauthorised persons. When the lamp



Locking Lampholder.

is inserted in the holder, a stud at the top is turned by means of a key, which locks the spring contacts. To remove the lamp, the key is turned in the opposite direction. The company supplies any type of bayonet holder fitted with this device at very nominal extra cost.

A new fan, styled the "Magnet," has also been introduced by the company. It is of quite new design, and is constructed with a permanent magnet field, thereby increasing the efficiency. The motor is fitted to a broad base stand, with knuckle joint, which will permit of the fan being used either as a bracket or pedestal. The



Magnet Fan and Battery.

commutator is of disk type, and the brushes are of pencil form, fed by small spiral springs. The parts can be easily detached and packed in a very small compass. Owing to the very small amount of energy consumed by this fan, dry batteries can be used for driving it, the number found advisable being two sets of four cells in parallel. These are supplied in suitable cases, already connected up.

**Sectional Conductor System.**—We have received from Messrs. Duckworth & Kerr, of 45, Lower Bank Road, Fulwood, Preston, particulars of a sectional conductor system which they have devised for electric railways. The inventors use a rail carried on springs just inside the running rail; this is depressed by a specially deep flange on one of the wheels of the train, and thereby actuates a switch, which connects a section of the third rail with a high pressure feeder. The spring rail is also in sections, which overlap, and apparently the trains must always run over it in the same direction.

**"Clincher" Expanding Plug.**—A new and improved pattern of expanding plug for plugging walls has recently been patented, in which the novel feature is the use of a conical wedge, with saw-cuts so arranged that the plug is not liable to split. The wedge, as usual, is at the inner end of the plug, so that a firm grip is obtained, and the outer end of the plug is left solid for the insertion of screws, &c. The device is styled the "Clincher" plug, and may be obtained from the wholesale supply houses, ironmongers, &c.

**The Transvaal.**—The value of the electric wire cables and fittings imported into the Transvaal during last year is returned at £77,000, as compared with only £65,000 in 1903.

**Fires.**—A small fire occurred last week in the stores of the Armorduct Manufacturing Co., Ltd., in Farringdon Avenue, E.C., and we are asked to correct the impression which appears to have got abroad that the occurrence will interfere with the execution of orders. We understand that it was quite an insignificant affair, which will not in any way interfere with the company's business.

The premises of Messrs. A. J. Noble & Co., at 172, Katherine Road, East Ham, having been burnt out, the firm is now carrying on business at 343, High Street North, Manor Park, E.

On Sunday morning the premises of Mr. Ernest Sykes, electrician, Lord Street, Halifax, were gutted by fire. The damage (£600) is covered by insurance.

**Fire Tests.**—The British Fire Prevention Committee's testing arrangements for May include a fire test with Messrs. Pilkington Bros.' horizontal skylights of wire glass in metal and wood frames (fourth test), and a test with a heavy floor of concrete with broad flange girders, supplied by Messrs. H. J. Skelton & Co. The tests next in rotation are, a test with a floor girder, and stanchion coverings, by the New Expanded Metal Co. (second test), a floor test by Messrs. Faber, of Berlin, an asbestic brick partition test by the Asbestic Brick and Tile Co. (second test), and various minor tests. The next report in preparation for issue is in respect to an automatic fire alarm system by the Autopyrophone Co., of Copenhagen.

**Book Notices.**—Messrs. Henry Sotheran & Co., of 140, Strand, have sent us their *Bibliotheca Chemico-Mathematica*, a catalogue of second-hand books, periodicals, &c., on scientific subjects, including the library of the late Prof. A. W. Williamson, F.R.S. This catalogue contains a great deal of interest to book-lovers, including rare copies of the works of Gilbert, Bernoulli, Bacon, Briggs, Kepler, &c. There is also a supplement containing particulars of new and standard scientific treatises.

"What do we Know Concerning Electricity?" By A. Zimmern, B.Sc. London: Methuen & Co. 1s. 6d. net.

"The Electro-magnet." By Chas. R. Underhill. London: E. and F. N. Spon, Ltd. 6s. 6d. net. New York: D. Van Nostrand Co.

"Electric Lighting." Vol. I.—The Generating Plant. By Francis B. Crocker. Sixth edition. London: E. & F. N. Spon, Ltd. 12s. 6d. net. New York: D. Van Nostrand Co.

*Science Abstracts*, March 25th, No. 87. Sections A., Physics; B., Electrical Engineering. London: E. & F. N. Spon, Ltd. 1s. 6d. each net.

"Die Elektrizitätswerke der Stadt München." By K. Meyer. Sonderabdruck aus der Zeitschrift des Vereines deutscher Ingenieure, Berlin,

*Dicks' London Street Guide* is a handy penny pocket publication whose object is to help one in finding the way about town. John Dicks, Effingham House, Arundel Street, Strand, W.C.

We have received a copy of the thirty-fifth annual edition of the "City of London Directory" (*City Press* Printing Works, 148 and 149, Aldersgate Street, E.C. 12s. 6d.). The work has been brought up to date, and in addition to the usual information concerning the City Corporation, the committees, the City officials, and the Livery Companies, there is a new feature consisting of the members of the London County Council committees. As this directory is not published before March, the editor has been enabled to record the Christmas and New Year removals. There is a very full alphabetical list of city firms and companies, and the names also appear arranged topographically, and according to the professions and trades followed. A large map of the city is included. It is one of the strongest bound among the directories that have come under our notice.

**Trade Announcements.**—The Langdon-Davies Motor Co., Ltd., have removed, from 25th inst., to larger works and offices at Southwark Works, Deverell Street, London, S.E.

Messrs. Baxendale & Co. have added a department to their Edinburgh house (44, Hanover Street) for the supply of electric lighting, bell and telephone fittings and accessories, and a large stock will be kept.

We are informed that Messrs. Wharam & Borland, Leeds, have purchased the stock of projection lamps, parts and patterns from the liquidator of A. J. Beaumont & Co., of York, and will in future supply and repair this type of lamp, in addition to their own well-known Scissors type.

Mr. H. J. Taylor having entered into partnership with Mr. J. O. Grant, electrical engineer and contractor, the firm will in future be known as Messrs. J. O. Grant & Taylor.

Messrs. Gard & Co., electrical engineers, of Canterbury, have removed their business to 52, St. Dunstan's.

The Sunbeam Lamp Co., Ltd., have now removed their London office to 102, Charing Cross Road, in accordance with the notice which recently appeared in these columns.

**For Sale.**—Messrs. P. Huddleston & Co. will, on April 13th and 14th, offer the stock and plant of Walker & Hodgetts, Ltd. (in liquidation), for sale by auction at Salford.

About 500,000 incandescent lamps are being offered for sale under the liquidation of the Sir Hiram Maxim Electrical and Engineering Co.

Messrs. Mellors, Basden & Mellors, of Nottingham, are offering for sale the stock-in-trade of an electrical engineer in Nottingham. Some particulars appear among our advertisements to-day.

**Dissolutions and Liquidations.**—The Electric Turbine Gas Retort Charging and Discharging Machine Co. is winding up voluntarily, with Mr. W. K. Wenham, 27, Martin's Lane, Cannon Street, E.C., as liquidator.

The Perfecta Seamless Steel Tube Co., Ltd., is winding up voluntarily, with Mr. R. A. Felton, of Edmund Street, Birmingham, as liquidator.

A meeting of the British Columbia Telephones, Ltd., is to be held at 49, Queen Victoria Street, E.C., on May 2nd, to hear an account of the winding up from the liquidator, Mr. M. Brewer.

The Hillgrove and Armidale Electrical Corporation is winding up voluntarily, with Mr. S. W. Money, 19, Broad Street Avenue, E.C., as liquidator.

The Electric Laundry Co., Ltd., meets at 57, Moorgate Street, E.C., on April 26th, to hear an account of the winding up from the liquidator (Mr. W. H. Chantry.)

A meeting of Electric Lighting Boards, Ltd, is to be held at 13, Basinghall Street, E.C., on April 27th, to hear an account of the winding up from the liquidators, Messrs. S. Greer and W. H. Pannell.

Messrs. G. C. Ching, H. G. Kettle and C. J. Edwards (Kettle and Co., electrical engineers, of Ipswich) have dissolved partnership. Mr. Kettle will carry on the business of an electrical engineer at 24, Lower Brook Street, Ipswich, under the style of H. G. Kettle and Co.

**Improved Patent Terminal.**—We have received from Messrs. Flitton & Coombs, of Caroline Street, S.E., a sample of "Middleton's patent terminal or coupling" for cables; this is constructed in the form of two grooved claws or washers, held together by a bolt and nut, and is intended to obviate the necessity of sweating eyes on cable ends. Three or four cables can be gripped in one terminal, so that it becomes a coupling. The device is also suitable for use as a dynamo or transformer terminal.

**Catalogues and Lists.**—The General Electric Co., Ltd., 71, Queen Victoria Street, E.C., have issued another "progress sheet," showing several new lines, including a lampholder with locking device, electric tail lamp for automobiles and cycles, heating accessories, &c. They have also sent us a booklet relating to the "Robertson" "Wytelite" lamps.

Messrs. Lehmann Bros, Hampshire Works, Station Road, Walthamstow, E., have sent us one of their new price lists of taps, screw plates, dies, &c., to British Association standard screw threads.

From Messrs. Clarke, Chapman & Co., Ltd., Gateshead-on-Tyne, we have received a well-illustrated and descriptive list of their electric winches, capstans and haulage gears. This list should prove of much interest to railway and ship engineers and the like. The machinery dealt with is eminently suitable for installation aboard ship for warping, discharging, &c., and we notice a very compact machine which Messrs. Clarke, Chapman supply for ash-lifting from the stokehold, dealing with mail matter from the hold, &c. The motor is shunt-wound and runs constantly. The barrel is loose on the shaft, and when required to hoist, the clutch lever is raised; this brings the friction cone into gear. The load is held on an automatic self-holding brake. The reduction gear between the motor and barrel is obtained by means of one set of worm gear. The capacity is 4 B.H.P., lifting 8 cwt. at 100 ft. per minute. Among others a 15-B.H.P. semi-portable single-speed winch, and a 50-B.H.P. slipway two-speed winch, are also shown.

A new and comprehensive brochure has come to hand from the Nernst Electric Light, Ltd., 82, Victoria Street, S.W., which deals very fully with all types of the Nernst lamp and its accessories. A brief description of the lamp is given and also some special points in regard to voltage, supply, &c. Tables of candle-powers for types "B," "D," and "A" and "Brilliant" are included.

Messrs. Defries & Sons, Ltd., 146—147, Houndsditch, E.C., have sent us a catalogue which fully describes the "Wirt" brushes for dynamos and motors, for which the company are the sole licensees in this country. From the same firm we have also received a leaflet relating to the "Wirt" jointless rheostats and theatre-dimmers.

A catalogue has come to hand from Messrs. Moul & Co., 76—78, York Street, Westminster, S.W., which deals very fully with their tachometer and tachographs and accessories in the way of pulleys, couplings, &c.; various technical points regarding types and sizes are also given, and anyone interested in these instruments should apply for a copy of this list.

The Worthington Pump Co., Ltd., 153, Queen Victoria Street, E.C., have sent us a pamphlet illustrating and describing their well-known types of barometric jet condensers, with pumping machinery required therewith.

Messrs. J. Butler & Co., Victoria Iron Works, Halifax, Yorks, have sent us a very nicely got-up cloth-bound catalogue, which illustrates and treats fully with the company's various machine tools. Engine and machine builders, ship engineers, tramcar builders, boiler makers, &c., should note this fact.

From Messrs. Green & Boulding, Ltd., 28, New Bridge Street, E.C., we have received a pamphlet dealing with the "Buffalo" automatic injectors, jet pump, the "Buffalo Duplex" boiler-tube scraper, steam indicators, calorimeters, valves, &c.

From the Electrical Co., Ltd., 121—125, Charing Cross Road W.C., we have received price sheets of their projector Nernst lamp, wall sockets and plugs and "change-over" concentric wall sockets.

Messrs. Lassen & Hjort, 52, Queen Victoria Street, E.C., have forwarded a copy of their latest catalogue bearing upon the Brunn-Lowener patent automatic water-softener and chemical grease extractor. It is very nicely got up, contains many good illustrations, a large list of companies and authorities using the firm's apparatus, and some testimonials, together with a general description of the plant itself.

Messrs. Chamberlain & Hookham, Ltd, Solar Works, New Bartholomew Street, Birmingham, have sent us a copy of their new catalogue. It is bound in a handy file, and contains much of interest concerning the firm's well-known electricity meters, and is well illustrated. In Section A a list of central stations is given where C. & H. meters are used. In Section D information is given regarding battery meters, and a new case in which the company is putting the meters, for attaching to switchboards. A new watt-hour-meter for traction switchboards is also illustrated; it is a modification of their ampere-hour type, with the permanent magnet driving field replaced by an electro-magnet; the former magnet being still retained for the brake. The advantages claimed for this meter are:—The absence of a commutator; it is not affected by stray fields, neighbouring conductors or short circuits; there is no wear on pivots, and no shunt running. For these reasons, the instrument is claimed to be a great improvement on the type hitherto employed for traction work.

## LIGHTING AND POWER NOTES.

**Australia.**—Claremont, W.A. — The recently completed municipal electric lighting scheme was formally opened on February 22nd, the light being switched on by the Mayoress. The plant comprises two Babcock & Wilcox boilers, each capable of evaporating 2,610 lb. of water per hour, fitted with superheaters, and also two Blake horizontal direct-acting pumps. The generating plant comprises two Willans engines direct-coupled to E.C.C. shunt-wound multipolar dynamos, each of 50 kw. capacity at 460 volts with a speed of 460 r.p.m., and also two E.C.C. balancers. The switchboard consists of four panels of enamelled slate, and is equipped with Messrs. Everett, Edgcumbe & Co.'s moving-coil instruments; each generator is protected by one of Messrs. Dorman and Smith's grip-contact circuit-breakers. Energy is distributed on the three-wire system by overhead mains carried on Hemsdorf porcelain double-shed insulators; the poles are of Jarrah, 30 ft. high. The streets are lit by 175 incandescent lamps, each 32 c.p., the lamps employed being of the new double spiral filament pattern, made by the Sterling Electric Co. The entire installation was carried out by Messrs. W. H. Kidston & Co. (formerly Messrs. J. Barrie Johnston & Co.), of Perth, under the supervision of their engineer, Mr. E. L. Webb, and to the specification of Mr. Rowley, the Council's consulting engineer. Private consumers are supplied by meter at a flat rate of 7d. per unit. Mr. F. Wilkinson is the municipal electrical engineer. The total amount raised by loan by the Council for E.L. purposes was £7,000, of which about £6,000 has been expended on the plant and mains, the balance being held in reserve as a nucleus to provide for extensions, provision for which has been made in laying out the building.

Sydney (N.S.W.).—Votes have been taken in the suburbs of Glebe and Balmain in regard to their respective Councils proceeding with an electric lighting scheme for the districts; in the former it was negatived, and in the latter the voting was in the affirmative.

Advice is to hand from Sydney, to the effect that judgement has been given in the proceedings taken against the Lord Mayor (Alderman Taylor) for being, as alleged, interested in certain electrical contracts for the city which were carried out by Messrs. Henley's Telegraph Works Co., Ltd. It was held that the facts showed nothing more than ordinary business transactions. Alderman Taylor had supplied timber to the company, but it was of no consequence what they did with it. They could use it for a contract with the Council or for any other purpose.

Brisbane.—From the *Australian Mining Standard* we note that the business hitherto carried on by the Brisbane (Q.) Electric Supply Co., Ltd., has been handed over to the City Electric Light Co., Ltd., the necessary sanction having been obtained from the Government to the transfer of the orders. These orders embrace the most important business area of the city, and have a tenure of 42 years. The new company is practically identical in *personnel* with the old company, but has been organised on a stronger financial basis, and in keeping with the valuations made in connection with the negotiations between the Brisbane City Council and the old company. It is anticipated that rapid extensions will be made in laying mains. The new company has an authorised capital of £100,000 in £1 shares, of which 60,000 have been issued; 20,000 of them are 6 per cent. preference shares.

Sydney.—The E.L. Committee has recommended the C.C. to rescind a resolution recently passed against the extension of the electric light outside city boundaries.

In response to a request from a large body of intending consumers, the E.L. Committee has also recommended mains extensions to Pearl Street, in order that a large section of Surry Hills might be served with light and power. Mr. Rooke, the engineer, in reporting upon the proposal, stated that the necessary expenditure would be £3,500, of which sum £800 had already been authorised, so that the actual extra outlay would approximately £2,700. In this was included the cost of erecting a sub-station. By the extension to Pearl Street about 56 gas lamps would be dispensed with, whilst the revenue would be, roughly, £1,000 per year.

**Bexley.**—The U.D.C. has adopted a new scheme for assisted wiring for the E.L. in shops and houses, the terms being as under:—

| Cost of installation. | Deposit (not returned) on acceptance of order. | Equal quarterly instalments spread over— 1 year. | 2 years. | 3 years. |
|---|---|---|---|---|
| £5 | £0 10 | £1 5 | £0 12 6 | £0 8 4 |
| 6 | 0 12 | 1 10 | 0 15 0 | 0 10 0 |
| 7 | 0 14 | 1 15 | 0 17 6 | 0 11 8 |
| 8 | 0 16 | 2 0 | 1 0 0 | 0 13 4 |
| 9 | 0 18 | 2 5 | 1 2 6 | 0 15 0 |
| 10 | 1 0 | 2 10 | 1 5 0 | 0 16 8 |
| 11 | 1 2 | 2 15 | 1 7 6 | 0 18 4 |
| 12 | 1 4 | 3 0 | 1 10 0 | 1 0 0 |

Lamps are not included in the estimated cost of installation, but can be purchased from the E.L. department. The work of wiring is to be put out by contract.

**Birkdale.**—The arrangement by which the Lighting Co. fit up house and shop installations free of charge, has been found to work very satisfactorily.

**Boston (Lincs.).**—With reference to the application of the T.C. for a loan of £20,000 for E.L. purposes, the L.G.B. has written to the town clerk making various suggestions and recommending the appointment of an electrical engineer.

**Burnley.**—The Corporation Electricity Committee has recommended the T.C. to apply to the L.G.B. for a loan of £6,105 for the provision of a 500-kw. steam generator for the electricity works.

**Dewsbury.**—This year, £1,000 is being transferred from the profits of the Corporation's electricity department towards the relief of the rates.

**Enniscorthy Asylum.** — The scheme for supplying electrical energy for power and lighting to the Asylum, which has been recently completed is as follows. A mill situated on the River Boro, 1½ miles distant, has been made use of as a generating station. The plant comprises an iron water-wheel, 24 ft. diameter × 20 ft. wide, having a capacity of about 120 h.p. on a 14-ft. head of water. It revolves three times per minute, driving a counter-shaft at 48 r.p.m., this driving the generator by a rope drive. The generator was specially designed to allow for the great variation in speed caused by the varying head of water at high and low tide. It has a capacity of 60 kw. at 350 r.p.m., with a speed variation of 15 per cent., and supplies current at 600—680 volts, the drop on the overhead conductors being 80 volts. This set is regulated from the Asylum board. All the conductors are carried on steel poles 31 ft. high, with the exception of the two on the banks of the River Slaney, which are 50 ft. A motor-transformer is installed at the Asylum, for reducing the pressure to 200 volts and 280 volts for charging the battery. The total water supply for the Asylum is supplied by electric motor pumps, and also the feed water to the heating boilers, and the laundry is driven by electricity; the power required being about 20 h.p. A reserve electric pump and a well have been provided near the River Slaney, and in the event of fire, a supply can be pumped direct from the river. The buildings are wired for 780 lights, equivalent to 40 h.p., and an extra 25-h.p. is required for pumping and power. The following firms carried out the work:—Messrs. Thomas Parker, Ltd., dynamos; British Insulated and Helsby Cable Co., overhead mains; British Westinghouse Co., motor pumps in Asylum; Messrs. Pflüger & Co., accumulators; Messrs. Kennan and Sons, Dublin, electric river pump; Messrs. Thompson, Kinsella and Jones, Dublin, counter-shafting. A compound condensing engine is also installed at the Mill, with a Lancashire boiler and Green economiser as a standby; these can be worked in conjunction with the water-wheel if desired.

**Electric Power on Board Ship.**—We learn from the *Shipping World* that on the new triple-screw turbine yacht *Albion*, which has just left Messrs. Swan, Hunter & Wigham Richardson's yard at Newcastle, where she has been built for Sir Geo. Newnes, electrical power is to be employed for all auxiliary purposes; cable windlasses, steering gear, boat hoists, ventilating fans, &c. The generators are in duplicate, and are driven by turbines. The combination of the sets and motors is slightly heavier than the combined weights of separate steam engines to individually drive the auxiliaries, but the great efficiency and economy derived by the use of electrical power in comparison with that of steam supplied through long lengths of piping, justifies its adoption; the little extra weight, in comparison, is of no consequence.

**Erith.**—The U.D.C. has received from the L.G.B. sanction to raise a loan of £19,878 for E.L. purposes.

**Exeter.**—At a City Council meeting last week, an allegation was made against one of the members, Mr. F. T. Depree (chairman of directors of Willey & Co., Ltd., lighting engineers, Exeter). During the discussion on the machinery of the new station, Mr. Munro objected to Mr. Depree speaking upon the matter, as his firm were interested as sub-contractors. He protested against a gentleman using his position upon the Committee and upon the Council, to further his own interest. Mr. Depree, however, stated that the whole of the transactions were completed before he became a member of the firm, and that he never had an opportunity of exercising a vote either in the Council or in connection with the company as regards the matter of the contracts.

**Frome.**—A L.G.B. inquiry was held on March 21st, relative to the U.D.C.'s application for a loan of £7,030 for electric lighting purposes. The amount is made up as follows:—Additional lamp-posts, £230; deficit on original contract, £1,483; increasing size of original engines, £551; new engine, dynamo, boiler and and pipe work, £4,150; meters, &c., £316; engineering expenses and contingencies, £400. There was no opposition.

**Hanley.**—The T.C. on Friday decided to grant £1,150 from the profits of the electric lighting undertaking in relief of the rates.

**Hemsworth.**—A local company is being formed with the object of securing a supply of electricity for the town, and already between 200 to 300 shares have been taken up.

**Ilford.**—A formal opening ceremony in connection with further extensions to the plant at the U.D.C. electricity works took place on Thursday last week, amid a large gathering. The chairman of the Lighting Committee called upon Mr. A. H. Shaw, the Council's electrical engineer, to give a description of the undertaking, and afterwards invited the chairman of the Council, Councillor R Stroud, J.P., to declare the extensions open, and to start up the new generating set that had been installed. Mr. A. H. Shaw commented upon the progress of the undertaking, and stated that he did not believe that any large power company could supply energy cheaper than the Council will be able to do. The price at present is 6d. and 2d., Brighton system, one hour, or 4½d. per unit, flat rate, and a reduction on these prices will shortly be made. Since we described the Ilford station in June, 1901, very rapid progress has been made in the undertaking. The total capacity of the plant at that date was 300 KW. In 1903 two 550-KW. sets, by Messrs. Dick, Kerr & Co., were erected, when the supply of energy to the tramways was started; at the same time two additional dry-back marine type boilers, by Messrs. J. Fraser & Sons, were also installed. To cope with the increasing demand, the Council resolved in December, 1903, to proceed with further extensions, and in the following July the L.G.B. sanction to a loan of £41,693 was obtained to carry out the work. Specifications for the new plant were prepared by Mr. A. H. Shaw, and the work of erection had been carried out under his supervision. These new extensions comprise one 1,000-KW. multipolar Westinghouse D.C. generator, direct-coupled to a triple-expansion condensing engine of 1,600 H.P., supplied by Messrs. Belliss & Morcom, Ltd., and designed to give 2,000 amperes at 500 volts, with a speed of 200 r.p.m., a surface condenser of a capacity of 27,000 lb. of steam per hour, with a Holden & Brooke grease separator, motor-driven air and circulating pumps, and Zschocke cooling tower. The whole of this latter plant was supplied and erected by Messrs. W. H. Allen, Son & Co., Ltd., and is similar to that supplied by them in 1903. The pipework is so arranged that either condensing plant may be used in connection with either cooling tower, and also so that either condenser may be used in connection with the new engines, or with the main exhaust of the smaller engines. Provision is made for running any or all the engines with exhaust to atmosphere. The extension switchboard panels for use in connection with the new plant, together with all instruments and cables, have been supplied by Messrs. Kelvin & James White, Ltd., and also the works distributing board, from which independent circuits are run to all auxiliary plant, enabling the power taken by each machine to be separately measured. The British Westinghouse Electric and Manufacturing Co., Ltd., have also supplied a balancer set with switchboard for same, and a reversible booster and board for use in connection with the battery on traction load, by which it is anticipated a considerable saving will be effected. Messrs. Lassen & Hjort have provided a water-purifying plant, which has been erected in the yard adjoining the engine room. The extensions to the engine room and switchboard gallery have been carried out to the designs of the Council's surveyor, Mr. H. Shaw. An "Ados" $CO_2$ recorder has also been installed in the boiler house.

**Kingston.**—A loan of £4,000, being part of the £15,650 authorised by the L.G.B., is about to be obtained by the T.C. It has been resolved to make a charge of 7d. per unit for energy consumed through penny-in-the-slot meters.

**Lancaster.**—The Electricity Committee has decided to grant discount to motor owners, ranging from 5 per cent. where the amounts are under £5 per quarter to 20 per cent. where the account exceeds £20. The L. & N.W.R. Co. have asked for a supply of energy to be laid to their new works in Lune Road. The cables for this will cost £690, and the Corporation has agreed to comply with the request on condition that the value of the energy used is up to 15 per cent. of the outlay. It has been decided to lay a new feeder cable to Meeting House Lane Bridge at a cost of £995.

**London.**—SOUTHWARK.—The B. of T. has transmitted to the B.C. the description of an additional system proposed to be adopted for the supply of energy by the London Electric Supply Corporation under their orders of 1889, 1890 and 1897 respectively. The Board intimates that it proposes to appove the system, and also to give its sanction to a scheme by the undertakers to connect part of their electrical circuits with earth. The communication is to be considered by a committee of the B.C. The E.L. Committee reported having had under consideration a letter from the County of London Electric Supply Co., Ltd., offering to supply the Council with energy at 2d. per unit for street lighting. This proposition, the Committee desired to point out, did not include attendance, trimming, repairs, &c., moreover, they were advised by the engineer that should the Council be in favour of further adopting electricity for street lighting, it could be profitably undertaken by the electricity department on the same terms, provided that the present system was extended to about 200 arcs, or the equivalent in side street lamps. The Committee had decided that no action should be taken on the letter.

WANDSWORTH.—Replying to the second letter from the B.C. on the subject of the audit of the accounts of the Wandsworth electric lighting undertaking, the B. of T. states it must adhere to its previous decision that it is not prepared to make any regulations in the manner indicated.

CAMBERWELL.—The Public Health Committee has accepted an offer from the County of London Electric Supply Co., Ltd., to provide a stand-by supply of electric light to the Old Kent Road baths, at the rate of 3½d. per unit, on the condition that no gas lights for illuminating purposes are to be installed, except in the wash-house portion of the building.

MARYLEBONE.—A letter was published in the *Pall Mall Gazette* recently, signed by "Some Marylebone Ratepayers," strongly opposing the suggestion of the B.C. to increase the pressure of supply from 100 volts to 240 volts, and to charge consumers on the maximum demand system.

**Long Eaton.**—A L.G.B. inquiry was held recently into the application of the T.C. to borrow £5,500 for E.L. purposes.

**Macclesfield.**—As a result of the visit of a deputation to the Board of Trade, the E.L. order, which Messrs. Foote and Milne had asked to be revoked, has been extended until the end of December next. The Council has already been advised by an expert that a scheme costing £14,000 could be undertaken with every prospect of success.

**Newark.**—At a meeting of the U.D.C. on Monday, it was reported that, provided it could be shown that the company had entered into a contract by which a supply of current would be available by December 31st next, a new agreement would be entered into with the Notts and Derbyshire E.L. Co.

**New York (U.S.A.).**—The State Legislature has appointed a Committee of Investigation into the alleged excessive charges for public gas and electric lighting in the city. Meanwhile the Mayor, Col. G. B. McClellan, has given instructions that the offers received on March 15th from the local lighting companies should be rejected, on the ground that there had been no material reduction of the rates quoted. The City Council is proceeding with the initial plans for a municipal plant, and the appropriation for a site has been passed unanimously, the amount allotted being £120,000. The New York Edison Co. has offered to reduce its rates from $146 to $120 for conduit-wired 2,000-C.P. arc lamps, and corresponding reductions on other kinds of lamps.

**Pembroke (Dublin).**—The sanction of the L.G.B. to the issuing of township redeemable stock for various sums of money is to be obtained, among which amounts is one for £25,000 for the extensions to the E.L. system.

**Shropshire and Worcestershire Power Scheme.**—The Midland Electric Corporation for Power Distribution has withdrawn its opposition to the Shropshire and Worcestershire Electric Power Bill.

**South Africa.**—*Beaconsfield, C.C.*—From the *Board of Trade Journal* we learn that the T.C. has decided to apply to the Cape Parliament for a prov. order to construct an electricity works within its district and to supply energy for lighting, power and traction.

*Cape Town.*—It is proposed by the Harbour Board Commission to spend another £60,000 for additional electric cranes.

## TRAMWAY AND RAILWAY NOTES.

**Belfast.**—The city surveyor (Mr. H. A. Cutler) recently reported that the carriage-way under the Great Northern Railway bridge at Bridge End could be lowered sufficiently to allow of double-decked electric tramcars passing underneath, but not enough to permit of canopy tops.

Applications made by sub-contractors for modifications in the terms of the contracts for tramcars and boilers respectively were received from the principal contractors, but these were declined, the Committee expressing their determination to have no variations.

A letter was received from the B.E.T. Co., intimating that they would be prepared to take a supply of current of at least 150,000 units per annum for the Cavehill and Whitewell tramways, and suggesting a method of fixing the price. It was decided to inform the company that the Committee would themselves fix the price, and the electrical engineer (Mr. McCowen) was instructed to report on the matter.

**Coventry.**—Lieut.-Col. Yorke made, on 21st inst., a Board of Trade inspection of the electric tramways extensions of the Coventry and District Electric Tramway Co.

**Electric Railways.**—In the House of Commons on 21st inst., Mr. Weir asked the Secretary to the Board of Trade if he would state the number of level crossings on the electrified portions of the Lancashire and Yorkshire and North-Eastern Railways, and the nature of the steps taken to warn and protect the public from accidents through contact with the electrically-charged rail. Mr. Bonar Law, in reply, said that on the electrically-equipped portion of the Lancashire and Yorkshire Railway there are 19 public and

33 private level crossings, and on the similar portion of the North-Eastern Railway the numbers are 18 and 29. Both railway companies state that the electric current is not carried over the crossings by means of a charged rail, but by a cable connecting with the "live" rail on either side of the crossing, and the ends of the rail are protected with non-conducting material. The companies also state that warning boards are fixed at the crossings.

**German High-Speed Railways.**—The Berlin correspondent of the *Evening Standard* reports that the Minister of Railways has presented a report to the Prussian Diet on high-speed electric trains. He states that such trains will probably be running in the near future for passenger traffic between great centres of population situated near each other. At present, high-speed electric railways are only practicable for short distances, and to introduce them for long distances would necessitate the complete reconstruction of existing lines, the improvement of the permanent way and the removal of all curves with a radius of less than 2,000 yds. Two plans for a high-speed electric railway between Berlin and Hamburg have been submitted to the Minister. One provides for a single line, at an estimated cost of £3,750,000. In the other which provides for a double line, the cost is reckoned at £8,000,000. In both plans it is proposed that the electric trains should run between Berlin and Hamburg without stopping, at an approximate speed of 90 miles an hour. The Minister of Railways adds that there would be great technical difficulties to overcome before this project could be realised. It would hardly be compatible with public safety, he thinks, to have points on a line on which such a speed was maintained; while, on the other hand, the absence of sidings for so long a distance would frequently give rise to great inconvenience.

**Italy.**—The authorities of the province of Rome propose constructing an electric railway connecting Rome with Civita-Castellena.

The Municipal Council of Venice has decided to purchase a number of electric sloops to be employed on the canals of the town.

The Adriatic Railway Co. intend constructing an electric line from Chiasso to Cowe and Chiavenna.

**Kidderminster.**—At the meeting of the T.C. on March 22nd, a letter was received from the Kidderminster and District Electric Traction Co., intimating that unless permission were given for the trams to run through the Bull Ring it would be impossible to work the proposed line to Bewdley either efficiently or profitably. The T.C., considering that it would cost £10,000 to widen the Bull Ring for tramway traffic, decided to take no action in the matter.

**Liverpool.**—The report on the working of the tramways for last year has just been issued by Mr. C. R. Bellamy, general manager. The number of cars fitted with top covers, and in service, is given as 317 out of a total of 350 which are to be fitted. As showing the effect of the top covers, it is stated that the average maximum number of cars in service during 1904 was 398 as against 407 in 1903, yet the passengers carried increased by 3,585,429. Six fatalities only had occurred in connection with the tramways during the year, while the number of persons who met their death through vehicles in Liverpool last year was 30. The ratio of fatal accidents to passengers carried was 1 in 19,440,444, as compared with fatalities on railways of 1 in 1,030,917. The cost of maintenance had decreased from £8,955 in 1901 to £4,809 in 1904. The total electrical energy used during the year for haulage and lighting of cars was 18,979,133 units, and 1,066,496 units in Bootle, a total of 20,045,629, as against 17,978,718 units for 1903, an increase of 11·49 per cent. The passengers carried numbered 116,642,663, the mileage run was 12,166,419 miles, and the receipts were £540,850, as compared with 113,057,234 passengers, 11,734,838 miles, and £524,468 in receipts in 1903.

**Liverpool and Southport Electric Railway.**—As showing the great increase of traffic on the Liverpool-Southport Railway, the electrification of which was inaugurated 12 months ago, it may be stated that for the month of December last there was an increase in the number of passengers on this line over the previous December, of 104,000. This week the full complement of 12 sets of electric trains has been in operation and steam trains have been entirely discarded, so far as the Southport section is concerned. At the present time about 80 electric trains arrive at Southport daily and the same number leave for Liverpool, making 160, as compared with about 90 when the service was worked by steam.

**London.**—On 24th inst. five drivers in the service of the L.C.C. were summoned at the South-Western Police Court for driving their electric cars along the south side of Clapham Common at a greater speed than 12 miles an hour. The complainants were the London Omnibus Owners' Federation. Mr. Rowsell argued on behalf of the Council that the section of the Act did not make individual drivers liable, but was aimed at those by whom the men were employed. The prosecution was rather a persecution arising from the petty jealousies of omnibus proprietors. He ridiculed the suggestion that it had been taken in the interests of the public. The magistrate imposed on each defendant a nominal penalty of 10s., but refused special costs.

Deptford.—The B.C. on Tuesday resolved to press upon the L.C.C. the necessity of a direct tramway service between Deptford and Vauxhall.

Wandsworth.—The B. of T. is to be asked by the B.C. to nominate a referee to settle a difference which has arisen with the L.C.C. on the question of tramway feeder pillars. The B.C. demands that certain pillars on the Clapham—Tooting line be removed. This the L.C.C. refuses to do unless permitted to replace them by others of a smaller type.

On Monday evening an electric car, while descending a steep hill, left the track at Wood Green and collided with a wall. No one was hurt. It is said that a trolley pole left the wire, and the brakes failed to act.

**Metropolitan District Railway.**—The District Railway Co. ran one of their new trains on Tuesday morning on a trial trip over the line from Mill Hill Park station, on the Ealing extension, to Whitechapel, *vid* Hammersmith, Earl's Court, Victoria, and Westminster to the City, and through to the East-end, thus completing the trials over the whole of the Inner Circle.

**Rio de Janeiro.**—The Rio de Janeiro Tramway, Light and Power Co. has been formed with a capital of £5,000,000. Among those financially interested in the new company are Sir William van Horne, of Montreal, and William MacKenzie and E. R. Wood, of Toronto, together with a number of New Yorkers. The company has a concession which gives it the exclusive right to transmit to the city of Rio de Janeiro electrical energy developed from water-power. The company has ordered half a million feet of conduit from the Standard Vitrified Conduit Co., of New York.

**South Shields.**—After another delay of several weeks' duration, the T.C. is back again to the position of going on with the tramways, the latest delay being due to the raising of the question whether or not 'buses were preferable to tramways. The matter was discussed, a deputation being appointed to visit various towns where they were in use, and report on the applicability of the system to the Tyneside borough. On the 22nd inst. the T.C. met, and decided to pursue the scheme of tramways with which it has been dallying so long. The minute of the deputation was:—"At a meeting on the 20th inst. the reports of the borough engineer and surveyor and electrical engineer in regard to the visits of the deputation to Birmingham, London, Eastbourne and Hastings were read. The deputation recommend that the reports as now altered be approved and submitted to the Tramways Committee; and (2) that as, in their opinion, the motor-'bus service is unreliable, the smell of petrol is highly objectionable, the vibration excessive and discomforting to passengers, the shocks at periods of stopping, starting and changing of speeds severe and objectionable; and, farther, as no reliable data are obtainable as to the working costs of the motor-'buses owing to the very short period they have been in use, but that everything tends to show that such working costs are high, and in excess of electric tramcar service, the deputation cannot recommend the Tramways Committee to adopt a motor-'bus service for this borough." This report was considered by the Tramways Committee, and although attempts were made to effect changes in it by the supporters of the 'bus suggestion, it was carried in its entirety, and forwarded to the Council for consideration. The matter was the subject of a very long discussion. Councillor Grant, in moving the adoption of the report, said the deputation had seen and inspected motor-'buses of various types at the places they had visited, and some of them they had found good, some bad and some indifferent. In the opinion of the deputation the streets of South Shields were not adapted to 'buses, and if the latter were adopted it would cost £55,000 to adapt the streets. Councillor J. W. Henderson seconded the report. He said that the capital cost of the motor-'bus system was equal to, if it did not exceed, the cost of the tramcar system. They would require at South Shields 30 'buses at £850 each, making £25,500, street works in the way of paving were estimated at £55,000, street lowering under bridges £6,255, setting back kerbs £2,250, alterations to tramway stables £1,000, Cuthbert and Frederick Streets works £19,000, and Fowler Street works £20,000, making a grand total of £129,000. Ald. R. Readhead opposed the motion, and contended that the decision of the Committee was entirely antagonistic to the reports of the officials. Every 'bus that the deputation travelled upon was of foreign make except one. The only perfect car upon which they travelled was the "Wolseley," which they saw in Birmingham. He was so satisfied with it, that he there and then made an offer for it. If they accepted his terms he would have the 'bus running on the streets of South Shields. He was so much in earnest that he would do it, and he was not afraid of the cost. He suggested that the matter should go back. Some discussion followed as to the deputation system, which was condemned by various speakers, and when a vote was taken the Committee's report was carried by 24 votes to 6.

**Tasmania.**—Messrs. Milnes-Daimler, Ltd., have lately shipped a double-deck petrol motor-omnibus to the Hobart Electric Tramways Co., Ltd.

**West Ham.**—It was reported at the Corporation meeting on Tuesday, that the treasurer, in framing his estimates for the coming year, had made provision for an anticipated deficiency of £2,000 on the working of the electric lighting undertaking. £8,000 had been contributed from the profits of the tramways undertaking for the relief of the rates for the current year. With respect to the estimate for the coming 12 months, he had been obliged to postpone making same until September, owing to the uncertainty as to the dates on which the lines now being electrified would be completed, the period the cars will be running, together with the increased capital charges. This report was adopted.

## TELEGRAPH AND TELEPHONE NOTES.

**Telephony.**—Mr. Herbert Laws Webb has been delivering a series of Cantor lectures on this subject before the Society of Arts. The third of the series was delivered on Monday evening last, when Mr. Webb dealt with the evolution of the telephone exchange, showing the early use of divided switchboards with electro-magnetic signals, and the use of the Law system to avoid using signals. Subsequent steps in the evolution of the switchboard described dealt with the series magneto multiple board, showing the defects of the series contacts and the bad electrical features; then the bridging board, which gave a balanced metallic circuit and automatically restored indicators; and finally the modern common battery board, with lamp signals and double supervision. The lecture was illustrated by a large number of slides, showing the different types of switchboard, and illustrating the improvements in both electrical and mechanical design, illustrating the different stages of construction of large telephone exchanges, and illustrating the requirements of a modern telephone building, which nowadays really houses a power plant on a small scale. The lecture was further illustrated by moving slides, throwing the shadows of actual apparatus on the screen. These slides showed the working of plugs and jacks of different types, ringing and listening keys, arresters and heat coils, and one slide showed the work of the line and cut-off relay of the common battery system, being worked from a telephone on the lecture table. The final illustration was a set of moving pictures of the London Wall Exchange of the National Telephone Co., which were taken in the middle of last week by the British Mutoscope and Biograph Co., and were a great success. They illustrated very strikingly the active work which goes on in a large city telephone exchange in the middle of the day. This is the first time that moving pictures of a working telephone exchange have been shown, and they were highly appreciated by the audience. Working installations of the three principal types of switchboard which illustrate the development of the telephone exchange, namely, the series board with hand-restored drops, the bridging board with automatically restored drops, and the common battery board with automatic lamp signals, were shown in operation by the kindness of the Western Electric Co.

**The Telephone Agreement.** — In the House of Commons the other day, Mr. W. W. Rutherford asked the Postmaster-General whether he could, and would, arrange in the agreement with the National Telephone Co. that until the transfer to the Government the requirements and plant shall be purchased exclusively from British manufacturers, so far as British manufacturers are able to supply the same, these requirements being upwards of £250,000 per annum. The Postmaster-General, in reply, said it was not open to him to modify the agreement in any respect. The agreement had been made, and it was now subject to the approval of Parliament.

**Telegraphists' Wages.**—Mr. Chamberlain is to receive a deputation of Midland telegraph clerks with reference to the report of the Bradford Committee on Post Office wages. He has, however, informed them that he cannot admit that the profits accruing from the working of the Post Office ought to be any criterion of the wages paid. "These profits are really made out of business done by the public, and are in the nature of taxation, which should go to the Exchequer and relieve taxation generally."

### Telegraphic Interruptions and Repairs:—

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Trinidad-Demerara (No. 1) | Aug. 26, 1901 | |
| Dominica-Martinique | May 7, 1902 | |
| St. Lucia-Martinique | May 7, 1902 | |
| Cayenne-Pinheiro | Aug. 13, 1902 | |
| Reissa-Issa (Yemen) Camaran | Oct. 22, 1902 | |
| Tarifa-Tangier | Jan. 18, 1904 | |
| Closed { Vladivostok-Nagasaki | Feb. 9, 1904 | |
| Closed { Port Arthur-Chifu | Mar. 9, 1904 | |
| Paramaribo-Cayenne | Feb. 25, 1905 | Mar. 23 |
| Jamaica-Colon | Jan. 5, 1905 | |
| Triest-Corfu | Mar. 23, 1905 | Mar. 28 |
| **Landlines.** | | |
| Puerto-Barrios | July 28, 1902 | |
| Kertch-Soutchoum | Sept. 27, 1904 | |
| Bhamo route beyond Tali | Jan. 15, 1905 | |
| Newfoundland—all places in the interior | Feb. 10, 1905 | |
| Indo-European | Mar. 25, 1905 | Mar. 26 |
| Rome-Pera | Mar. 22, 1905 | |

**Underground Cables.**—The Post Office telegraph cable from London is on the eve of completion as far as Carlisle, and in the course of the next financial year the service will be extended to Glasgow. A settlement has taken place in the dispute between the Postmaster-General and the Lanarkshire County Council with regard to the laying of the Glasgow line. The settlement between the parties is that certain of the pipes in the roadway shall be shifted, and that the new pipes shall be laid in a position to give the water-pipes a sufficient clearance.

**Wireless Telegraphy.**—In reply to a question asked in Parliament, Mr. Bonar Law states that communication by wireless telegraphy is about to be established between six lightships and the shore, and if the experiment is found to be successful, the system will no doubt be extended to other outlying light stations.

Press dispatches from New York state that on 22nd inst. a wireless message from the steamer *Bermudian*, dispatched 380 miles off New York to the owners in New York, skipped all the seaboard stations and reached Cleveland, over 500 miles inland.

The Canadian Government has decided to place a Marconi wireless telegraph station on Table Island. It will come into operation about August 1st next.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Aberdeen.**—April 19th. Surface condenser, &c. See "Official Notices" March 24th.

**Africa.**—May 15th. The General Government of French West Africa at Dakar, is inviting tenders until May 15th, for the establishment of a central electric lighting and power station at Dakar.

**Batley.**—April 17th. Tramway reconstruction, permanent way, overhead equipment, cables, conduits, &c. See "Official Notices" March 24th.

**Birmingham.**—April 4th. The Corporation Tramways Committee requires tenders for supply, delivery and erection of 200 tramway cars. Form of tender, &c., on payment of £2, from Mr. A. Baker, general manager, 254a, Corporation Street, Birmingham.

**Clyde.**—April 10th. Electric power plant for Clydebank Dock. See "Official Notices" March 10th.

**Colchester.**—April 5th. Condensing plant and electrically-driven pumps. See "Official Notices" March 24th.

**Dewsbury.**—April 17th. Tenders are being invited for the relaying and electrical equipment of the steam tramway system between Dewsbury and Gomersal:—(1) Permanent way construction and paving; (2) overhead equipment, steel poles &c.; (3) feeder cables, conduits and accessories.

**France.**—Correze.—The Municipal Council of Argentat has just decided to install an electric central station at Corrèze. Proposals are invited from manufacturers.

**France.**—May 14th. Tenders are being invited until May 14th, by the municipal authorities of Dax (Landes) for the concession for the electric lighting of the town during a period of 35 years. Tenders are to be sent to La Mairie de Dax (Landes), whence particulars can be obtained.

**Hammersmith.**—April 5th. Boiler flues and economisers, piping, feed heater, coal elevator, &c. See "Official Notices" March 17th.

**Holland.**—April 8th. The Municipal Authorities of Utrecht are inviting tenders until April 8th, for the supply of 20 electric motor tramcars.

**Johannesburg.**—April 27th. Switchboards and accessories for the new direct and alternating current power station. See "Official Notices" to-day.

**Johannesburg.**—May 7th. Tramway poles, feeder pillars, overhead material, telescopic ladders, motor tower wagon, &c. See "Official Notices" March 17th.

**Le Touquet and Paris Plage.**—Offers are invited for the electric lighting concession for these two resorts. See our "Official Notices" to-day.

**London.**—April 4th. Eight 500-kw. induction motor-generators for L.C.C. tramways sub-stations; wiring material, cables, cable-boxes, &c. See "Official Notices" March 17th.

**Luton.**—April 15th. Plant extensions for the electricity works. See "Official Notices" to-day.

**Manchester.**—April 4th. High and low tension switchboards. See "Official Notices" March 17th.

**Marylebone.**—April 4th. House meters for two years. See "Official Notices" March 4th.

**Nuneaton.**—April 10th. Cables and joint-boxes for the electricity department. See "Official Notices" to-day.

**Penang.**—April 18th. A 300-kw. steam dynamo, motor generator, balancer, switchboards &c., for the Municipal Council. See "Official Notices" to-day.

**Spain.**—April 8th. The Spanish Ministry of Public Works in Madrid is inviting tenders until April 8th, for the concession for the construction and working, in Madrid, of an electric tramway between the Calle del Barquillo and the Plaza de Olavide.

---

**CLOSED.**

**Barnsley.**—We are informed that the note that appeared in our last issue was slightly incorrect. It should have read thus:—The tender of Messrs. D. Bruce Peebles & Co., for the supply of a 400-kw. steam dynamo to the Corporation Electricity Works, has been accepted. The contract for the boilers and fittings has not yet been let.

**Bedwellty.**—The B.G. on March 22nd accepted the tenders of Messrs. Edwards & Armstrong, of Cardiff, and Messrs. Vaughan & Co., of Bristol, for the installation of the E.L. at the Workhouse. The scheme will cost £2,289 10s.

**Derby.**—The Corporation Tramways Committee has accepted the tender of Messrs. W. Griffiths & Sons, of London, for extending the electric tramway from the Derby House Road to Upper Dale Road, at £18,689, and that of the Brush Electrical Engineering Co., Ltd., of Loughborough, for four tramcars.

**East Ham.**—The T.C. has placed an order at £247, with Messrs. Callenders, for traction feeder cable.

**Erith.**—The U.D.C. received the following tenders for assisted wiring on the premises of consumers for the E.L.:—

J. T. Jarvis & Sons, Erith (accepted), 10s. 6d. per point.
W. Dickinson, Bexley Heath, 10s. 9d.
G. A. Moore, Belvedere, 12s. 6d.
Woodville Electric Co., Belvedere, 12s. 10d.
Hooper, Nearey & Co., Greenwich, 14s.
Ward Bros., 28A, Basinghall Street, London, E.C., 14s.

**Fulham.**—The B.C. has received the following tenders in connection with the electric lighting extension scheme:—

| | Condensing Plant. 28 in. vacuum. | Alternative. 28 in. vacuum. |
|---|---|---|
| Schwarz & Co. | £2,145 0 0 | — |
| Balcke & Co. | 1,942 19 6 | — |
| Ashwell & Nisbet | 1,940 15 0 | £1,880 15 0 |
| Summers & Scott | 1,720 0 0 | 1,430 0 0 |
| Thornton & Co. | 1,709 0 0 | 1,625 0 0 |
| Wheeler Condensing Co. | 1,681 0 0 | 1,395 0 0 |
| Storey & Sons | 1,655 15 0 | 1,330 12 0 |
| Cole, Marchant & Co. | 1,579 10 0 | 1,214 10 0 |
| Belliss & Morcom, Ltd. | 1,572 0 0 | 1,392 0 0 |
| Carrick & Wardale | 1,544 0 0 | — |
| Bertrams, Ltd. | 1,505 0 0 | 1,251 10 0 |
| Scott & Co. | 1,481 0 0 | 1,256 0 0 |
| Musgrave & Co. | 1,481 0 0 | — |
| Mirrlees, Watson & Co., Ltd. | 1,475 0 0 | 1,145 0 0 |
| Masson & Scott | 1,170 0 0 | 1,205 0 0 |
| Bailey & Co. | — | 1,450 0 0 |
| Richardsons, Westgarth & Co. | 1,486 0 0 | 1,185 0 0 |
| Coombe, Barbour & Co. | 1,405 0 0 | 1,356 0 0 |
| Mather & Platt, Ltd. | 1,388 0 0 | — |
| Worthington Pump Co., Ltd. (accepted at £1,119 10s.) | 1,383 0 0 | 1,119 10 0 |
| W. H. Allen, Son & Co., Ltd. | — | 1,192 0 0 |

| Boilers. | |
|---|---|
| Rowland & Co., Ltd. | £2,720 |
| Danks & Co., Ltd. | 2,412 |
| Hewitt & Kellett, Ltd. | 2,154 |
| Stirling Boiler Co., Ltd. (accepted) | 2,211 |
| Babcock & Wilcox, Ltd. | 2,050 |
| Fraser & Fraser (informal) | — |

| Economisers. | |
|---|---|
| Goodbrand & Co. | £2,751 |
| Clay Cross Co. | 2,665 |
| Lowcock & Co. | 2,665 |
| W. Windsor | 2,650 |
| E. Green & Son (accepted) | 2,640 |
| Danks & Co. | 2,640 |
| Stirling Boiler Co. | 2,158 |
| Carter & Sons | 2,105 |

| Fittings and Stokers. | |
|---|---|
| Erith's Engineering Co., Ltd. | £1,669 |
| Rowlands & Co. | 1,321 |
| Danks & Co. | 1,190 |
| Underfeed Stoker Co. | 1,083 |
| " " " alternative (accepted for four stokers, at £454) | 875 |

**Gloucester.**—The Electricity Supply Committee of the T.C. has accepted the following tenders in connection with the Electricity Works extension:—

Messrs. H. & T. Danks, Netherton, boilers.
Phœnix Dynamo Co., Ltd., Bradford, Sisson engine and dynamo.
Mirrlees, Watson & Co., Glasgow, condensing plant.
Mr. Joseph Gurney, Gloucester, buildings.
Edward Le Bas, London, pipework.
India-Rubber Co., Ltd., Silvertown, feed pump.

**Lancaster.**—It has been decided to place the orders for new cars, unconditionally, with the British Westinghouse Co., because the cost of making the bodies at the Metropolitan Wagon Co.'s works would be £55 per car more.

**Southend-on-Sea.**—The T.C. has accepted the following tenders:—

Stirling Boiler Co., Ltd., Motherwell, N.B., two boilers, each capable of evaporating 10,000 lbs. of water per hour, £2,972.
Electric Construction Co., Ltd., Wolverhampton, steam dynamo of 350-kw. capacity, driven by a Howden triple-expansion engine, £2,946.
Messrs. J. Carter & Sons, Stalybridge, economiser, £614.
General Electric Co., Ltd., London, two motor-driven feed pumps (pumps by Worthington & Co.), £602.
Hart Accumulator Co., Ltd., Stratford, renewal of positive battery by fixing 132 standard cells, £331, and maintenance for 10 years, at £39 per annum.

**Southwark.**—The B.C. has accepted the tender, at £52 16s., of Mr. W. Winn, for installing the electric light in the new Museum Building. There were eight tenders varying from that accepted, up to £175.

**Wolverhampton.**—The contract for the installation of electric light in the Queen Victoria Nursing Institution, has been given to the District Electric Co., of Wolverhampton.

---

## FORTHCOMING EVENTS.

Saturday, April 1st.—At 7.30 p.m. Glasgow Technical College Scientific Society, Annual general meeting.
Monday, April 3rd.—At 7.30 p.m. Society of Engineers. Meeting.
At 8 p.m. Society of Arts. Cantor Lecture by Mr. H. Laws Webb, on "Telephony." (Lecture IV.)
Tuesday, April 4th.—At 8 p.m. Faraday Society. Mr. A. H. Hiorns on "Alloys of Copper and Antimony and Copper and Bismuth." Discussion on Mr. E. K. Scott's paper on "Refractory Materials for Furnace Linings." Messrs. R. S. Hutton and W. H. Patterson on "Electrically-Heated Carbon Tube Furnaces." (I.)
Thursday, April 6th.—At 5 p.m. Royal Institution. Prof. R. Meldola, F.R.S., on "Synthetic Chemistry" (experimental). Lecture I.
At 7 p.m. Junior Institution of Engineers. Visit to Willesden power house of the M.E.P. Supply Co.
At 8 p.m. I.E.E. Discussion on the report on the International Electrical Congress at St. Louis, by Mr. W. Duddell. Papers on "Systems of Electric Units," by Prof. Ascoli, Prof. G. Giorgi, Profs. H. S. Carhart and G. W. Patterson, and Dr. F. A. Wolff.
At 8 p.m. Chemical Society. Meeting.
At 8.15 p.m. Röntgen Society. Meeting at Hanover Square.
Friday, April 7th.—At 7 p.m. I.E.E. (Manchester Students). Annual general meeting at the Salford Royal Technical Institute. "Electric Cranes," by Mr. Jennison.
At 9 p.m. Royal Institution. "American Industry," by Mr. Alfred Moseley, C.M.G.
Saturday, April 8th.—At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Meeting.
Monday, April 10th.—At 8 p.m. Institution of Civil Engineers. Special Meeting. The thirteenth "James Forrest" lecture, by Col. R. Crompton, C.B., on "Unsolved Problems in Electrical Engineering."

---

## THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following are the orders for next week:—

Monday, April 3.—"A" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Tuesday, April 4.—"B" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture on "Details of Lamp and Engine," by Capt. J. H. S. Phillips, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m.
Wednesday, April 5.—Submarine mining class, 6—9 p.m. Instruction in "Stoking Steam Engine," by Captain W. Bunn, 6.30 p.m. Examination "A" and "B" Companies for "A" badge, 7 p.m.
Thursday, April 6.—"C" Company. Recruits' drill, 6 p.m; technical instruction, 7 p.m.
Friday, April 7.—"D" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture by Capt. R. Wallis-Jones, 1st Mon. R.G.A. (V.), on "Field Artillery Work," 8.30 p.m.
Saturday, April 8.—Week-end class.

Wilfrid C. Dumble, Captain R.E.
For O.C.E.E.R.E. (V.)

---

## NOTES.

**Electric Smelting.**—It has been said in many quarters that the "dumping" of German and American steel into England, is ruining our own steel industry. On the other hand, there are those who contend that the cheapness of the "dumped" material has enabled us to manufacture the *finished* article, and so beat the Germans in their own market. One thing, however, is quite certain, and that is, we have not yet taken advantage of methods which are ready at hand for cheapening our products in the way our foreign competitors have forged ahead, and we can only hope with Mr. Blount that the facts ascertained by the Commission sent to Europe last year by the Canadian Government, and which formed the basis of the paper read by Mr. Harbord, before the Faraday Society (see p. 516 of this issue), will show our steel masters that it is not a fiscal tariff reform which is needed, but improved and cheaper methods of manufacture to keep the Old Country still ahead of all rivals. *Now is the time*, said Mr. Blount, to apply electro-metallurgical methods to the steel industry of the country, and now is the time, we may add, for a revivalist preacher to convert our steel makers to the new order of things.

**Football.**—A match was played on Saturday, March 25th, 1905, at Wormholt Farm, Shepherd's Bush, between teams representing the Eastern District and West End Sections of the Charing Cross, West End and City Electricity Supply Co. A very good game resulted in a win for the City Section by 4 goals to 2, although the West End was leading 2 to 1 at half-time. The goals were scored by Jones (3) and Rogers for City, and Bray (2) for West End. The match was well attended by the employés and friends.

**Electrical Chess Club.**—The Electrical Chess Club encountered the General Electric Co. Chess Club on Thursday, March 23rd, in the club room of the former (Carr's Restaurant, Strand). The following is the score:—

| Electrical Chess Club. | | General Electric Co. C.C. | |
|---|---|---|---|
| 1. Mr. Elder | 1 | Mr. Tucker | 0 |
| 2. Mr. Tegetmeier | 0 | Mr. Littleton, sen. | 1 |
| 3. Mr. Parnell | 1 | Mr. Littleton, jun. | 0 |
| 4. Mr. Somerville | ½ | Mr. Whitford | ½ |
| 5. Mr. Garcke | 1 | Mr. Nye | 0 |
| 6. Mr. Dade | ½ | Mr. Robson | ½ |
| 7. Mr. Holt | ½ | Mr. Perry | ½ |
| 8. Mr. Cook | 1 | Mr. Holt, sen. | 0 |
| | 5½ | | 2½ |

**Boiler Scale.**—A writer in the *American Electrician* recommends trisodium phosphate as the best disincrustant for boilers, on the grounds that it causes the scale-forming salts to deposit in an absolutely non-adherent form. He gives the cost of softening plants at 16s. to 20s. per horse-power for plants below 1,000 H.P., and at 12s. to 15s. up to 2,000 H.P., while up to 5,000 H.P. the cost may be as low as 8s. We think all these prices are high for English practice. The reagent named costs 2d. to 2½d. per lb. in America. We do not understand the author's allusion to boiler feed-water laden with *acids* that tend to form boiler scale, unless acid is used in some different sense in America from what it is here, for acid waters do not scale. Acid usually strips a boiler of scale, and keeps the plates wasting too rapidly for scale to adhere had it been present.

**Calorific Capacity of Fuel.**—A correspondent referring to the boiler efficiency of 84·9 per cent. claimed by Mr. Fedden at page 400, Electrical Review, March 10th, 1905, asks why and how Shireoaks slack coal is stated to possess only 11,886·7 B.Th.U. calorific capacity. Shireoaks is one of the best of the excellent South Yorkshire coals, and the calorific capacity of this coal is close upon 14,000 B.Th.U., or, say, 2,000 more than that taken to give the high result claimed. Reduced in this ratio, the more probable efficiency of about 72·9 per cent. would be shown. Specially high results can always be got by putting the calorific capacity of fuel too low, and such poor stuff as this supposed Shireoaks slack hardly seems rational, he says, so near to the pit as Sheffield.

**The Optical Convention.**—Arrangements are taking definite shape for this convention which will be formally opened with an address from the President, Dr. R. T. Glazebrook, M.A., F.R.S., on Tuesday, May 30th, and the gathering will extend over the four following days up to and including Saturday, June 3rd. The mornings will be devoted to papers and discussions. In addition to the papers, demonstrations of apparatus of special interest will be given in the afternoons in the laboratories of the Department of Technical Optics of the Northampton Institute. The exhibition of optical and scientific instruments will be held in the large hall of the Northampton Institute. There will be an evening lecture by Prof. Silvanus P. Thompson, D.Sc., F.R.S., on "The Polarisation of Light by Nicol Prisms and their Modern Varieties." On a third evening it is proposed to hold a conversazione; and for the Saturday afternoon, a visit to the National Physical Laboratory at Teddington is proposed, at the kind invitation of Dr. Glazebrook. The subscription for membership is 5s. The hon. secretary, Mr. F. J. Selby, Elm Lodge, Teddington, Middlesex, will be glad to hear from those wishing to join the convention.

**The Electrical Exhibition, 1905.**—We are informed that the first meeting of the Executive Committee was held at the Hotel Cecil on March 21st, and was attended by the following members:—Messrs. H. Bevis, O. H. Bishop, T. C. Elder, C. S. Northcote, S. Baynes, E. Cunliffe Owen, H. W. Butler, J. E Kingsbury, H. Oppenheimer, Sydney Dobson and W. Davenport (secretary). Mr. E. Cunliffe Owen was unanimously elected chairman, and Mr. C. S. Northcote deputy chairman. The appointment of Mr. W. Davenport as secretary was confirmed. The Committee, after hearing the secretary's report of the arrangements made up to date, discussed and settled matters appertaining to the management. It was decided that the Exhibition should be held at Olympia from September 25th to October 21st inclusive. Instructions were given to issue the necessary prospectus as soon as possible, it being stated that many applications for space had already been received. Finance and General Purposes Committees were appointed. Sir Wm. H. Preece, K.C.B., was unanimously invited to accept the Presidency of the Exhibition. Messrs. Bridges & Smith, of Balfour House, Finsbury Pavement, were appointed managers, and all inquiries respecting the allotment of space should be addressed to them.

The following is a list of the names of the Executive Committee as appointed up to date. The Municipal Electrical Association (Incorporated) having still to elect their representative, there remains one nomination from the exhibitors still at the disposal of the Committee. We learn that the supply companies and the municipal authorities generally over the country are freely giving support to the undertaking.

*Executive Committee.*—S. W. Baynes, St. Pancras Electric Works; H. Bevis, General Electric Co.; O. H. Bishop, Edison & Swan; H. W. Butler, Electrical Power Storage Co.; E. Cunliffe Owen, Metropolitan Electric Supply Co.; Sydney T. Dobson, St. James' and Pall Mall Electric Light Co.; T. C. Elder, Brush Electrical Engineering Co.; J. E. Kingsbury, Western Electric Co.; C. S. Northcote, Veritys, Ltd.; H. Oppenheimer, International Electric Co.; W. S. Packenham, Crompton & Co.; W. H. Patchell, Charing Cross, West End and City Electricity Supply Co.; Roland S. Portheim, Bruce Peebles & Co.

**Institution and Lecture Notes.**—At the Royal Society meeting yesterday, Mr. A. H. Peake read a paper on "The Determination of the Specific Heat of Superheated Steam by Throttling, and Other Experiments"; communicated by Prof. J. A. Ewing, F.R.S.

On February 21st Mr. G. W. Worrall, M.Sc., M.Eng., read a paper before the Liverpool University Engineering Society on the subject of "Electrical Transmission." The author pointed out the necessity of high pressure and small current in the line, and of transforming down to moderate pressure at the motors, which has usually led naturally to the use of alternating currents; but the direct current series system had certain advantages, especially that of freedom from troubles due to inductance and capacity. The latter were so great with alternating currents, that for long-distance transmission aerial lines were alone practicable. The unique system developed by M. Thury was briefly described (see Electrical Review, September 12th, 1902, p. 463). A drawback to the system was the fact that the line loss was constant at all loads; on the other hand, waterfalls at long distances apart could be joined up, with the consumers between, in series, forming a huge loop consisting of a single line. The author suggested that the system was not dangerous to life or property, because only one line passed through the point of demand, but this is obviously an untenable proposition. Mr. Worrall concluded his paper with a reference to the necessity of speed regulators on the motors, shunting the series coils, and pointed out the fact that the machines were not liable to damage through overload.

Dinner of the Association of Engineers-in-Charge.—On Saturday last the tenth annual dinner of this Association took place at Liverpool Street Hotel, Dr. A. B. W. Kennedy, F.R.S., presiding. The company numbered 316, of whom a large proportion were guests. After the loyal toasts, the chairman proposed the toast of "The Association," congratulating it on the papers and discussions at its meetings, and on its policy of mutual aid. Referring to the fascinations of engineering, he gave a humorous account of his own career, and described how he designed the first compound engine put on board a ship by Palmer's. Juniors were apt to think that they did all the work, and their chiefs did nothing; but they must not forget that they (the juniors) had the best of the real engineering, while the seniors had the much less congenial task of organisation to perform. In his reply, Mr. J. Patten Barber, vice-president, eulogised the work of the hon. secretary, Mr. H. Capsey, and said that the Association was particular as to the qualifications of its members. Engineering, he said, was the best profession in the world, but not everyone who thought himself a "born engineer" was an engineer, though he might become one by diligent effort. Proposing "The Chairman of the Evening," Mr. W. T. Hatch, the president, read a sheaf of notes dealing with Dr. Kennedy's whole career, from the time when as an apprentice he had dirty hands and face. In his reply to the list of distinctions, the reading of which must have been a trying ordeal to him, Dr. Kennedy pointed out that dirty hands were nothing to boast of; engineers in America took great care of their personal appearance, and they were right. Mr. W. C. C. Smith proposed the toast of "Our Authorities," and eulogised the self-sacrificing enthusiasm of municipal committee-men, while London he regarded as the best-managed municipality in the world. The Mayor of Wandsworth replied, and complimented the members upon their intellectual appearance. Referring to the authorities whom he represented, he told a story of certain hens which had begun to eat their own eggs, and therefore "would soon be self-supporting," as exemplifying the present state of the rating question in London. He also dealt with the problem of finding work for the deserving unemployed during the past winter. Mr. J. Brown, who followed on the same side, advocated economy, and contentment with existing plant. Mr. J. S. Ardley, chairman of the Association, proposing the toast of "The Visitors," expressed the indebtedness of the Association to its visitors, who read papers and gave valuable advice and assistance to the members. Mr. T. D. Mann and Mr. J. Adamson replied. Lastly, "The Press" was toasted by a member bearing the appropriate name of Penn, and after Mr. A. F. May had replied briefly, the proceedings came to an end. During the dinner a programme of music was performed, and songs were interspersed between the speeches, under the musical direction of Mr. George Hardy. The function was in every way an unqualified success.

At the meeting of the Liverpool Engineering Society on March 22nd, Mr. H. W. Wilson read a paper on "Electric Traction on Main Line Railways." After referring to the different conditions under which main line and other traffic had to be carried on, Mr. Wilson proceeded to speak briefly of the chief points of electric railways now at work. On the basis of known facts, he considered that it would be necessary, for the operation of main lines by electricity, to use extra high pressure generation, alternating current with comparatively high voltage supply, and overhead conductors. He believed that in practice joint power houses worked by companies in common would be needed to give the best results, and that the drop of voltage on the return circuit was a governing factor. It had, moreover, been proved that only something like 21 per cent. of the energy supplied was really used up in propulsion, the rest going to waste in friction and other ways. Speaking on the financial aspect of electrification, Mr. Wilson said that when

it was considered that the locomotives of the London & North-Western Railway alone were worth £7,000,000, and that the cost of electrical equipment would be twice as great as the loss on the existing equipment if discarded, it was evident that the economical advantage of electrical propulsion would have to be unmistakably made out before boards of directors could venture on the change. The methods of electrification adopted for local lines were unsuitable for main lines on the score of cost alone.

On 20th inst., at a meeting of the Engineering and Scientific Association of Ireland, held in the Royal College of Science, Dublin, Mr. P. S. Sheardown, M.I.E.E., read a paper giving his "Impressions of a Recent Visit to America."

The Junior Institution of Engineers recently visited the Brockie-Pell Arc Lamp Works, Worship Street, London, the members being received by Mr. James Brockie, who gave an account of the Brockie-Pell lamp, its development and construction, and described generally the necessary characteristics of an efficient arc lamp. In the workshops a number of lamps of different types were shown in course of manufacture, and in the testing room demonstrations were carried out to illustrate the effect on the arc of two methods of regulation, namely, differential (main coil and shunt coil working in opposition) and shunt coil only, the result shown being that with the shunt coil alone the current might be varied very considerably without affecting the length of the arc, whereas, with the differential method, the variation in length of the arc was very considerable with the same change in the current strength. The two lamps were run in series.

**Cricket Fixtures Wanted.**—The cricket club formed by the staff of the City Road station of the County of London Electric Supply Co. is desirous of arranging matches with other supply station clubs during the coming season. They have obtained an L.C.C. pitch at Finsbury Park for the following dates, all of which are vacant at present:—June 3rd and 17th, August 12th and September 9th and 23rd. They also have all other Saturdays (except June 24th) available for away matches. Mr. A. Allsop is the hon. secretary, and communications should be sent to him at City Road station.

**Engineering Standards.—The Electromobile Sub-Committee.**—Mr. Leslie Robertson, the secretary of the Engineering Standards Committee, informs us that the Sub-committee on Electromobiles, under the chairmanship of Mr. W. Worby Beaumont, has now commenced its labours. The following is the list of members:—Mr. W. W. Beaumont (chairman), Col. R. E. Crompton, C.B., Col. H. C. L. Holden, R.A., Mr. R. M. Campbell, Mr. Theodore Chambers, Mr. Arthur Greenwood, Mr. Llewellyn Preece, Mr. Percy Still.

**Payment for Specifications.**—Our attention has been drawn to the fact that Mr. H. B. Buckley, architect, in issuing specifications for electric lighting on behalf of the Batley Co-operative Society, has levied a charge of 10s., *not* returnable, upon applicants for copies of the specifications. This novel practice has evoked protests from several of the contractors who applied, and is one of which we strongly disapprove. Surely the burden of preparing specifications free of charge is a sufficiently heavy one, without compelling would-be tenderers to pay for that valuable privilege. The architect avers that the course in question was adopted with the intention of preventing "inferior small firms" from tendering, so as to "give the better a fair chance of giving a proper tender for the work." Moreover, he says that it was done with a purpose, and "has answered its intentions" The question arises, Whose property are the specifications? We consider that they belong to the Batley Co-operative Society, which, however, professed its ignorance of the fact that they were being charged for, and we should like to know who retained the purchase price of these documents. Next, we fail to see how the course adopted is going to hinder the small firms from tendering; we think it is much more likely to annoy the bigger firms, whose position enables them to decline to tender. How the proceeding can possibly benefit the Co-operative Society is a mystery; presumably the architect has certain "small firms" in his mind, but their tenders could have been rejected with perfect ease when they were received. If the object were to save himself trouble, it was an unworthy one. In fine, we can see absolutely no justification for the practice, and we are pleased to add that strong protests have been submitted by the Leeds Branch and the Northern Section of the Electrical Contractors' Association.

**The McMillan Fund.**—At the last meeting of the Institution of Electrical Engineers, the President, Mr. Alex. Siemens, announced that the above fund, amounting to £2,082, had been invested, in accordance with the original intention of the promoters, and that the trustees of the fund were Sir William Preece, Mr. Robt. Kaye Gray and himself.

**Appointments Vacant.**—Clerk of works for the installation at the Cumberland and Westmorland Joint Lunatic Asylum; fitter-driver for Greenock electricity works (38s.).

**A Short Circuit at Niagara.**—Mr. Orrin E. Dunlap, of Niagara Falls, writes:—"A short circuit of terrific force and volume occurred under switchboard No. 1, in Power House No. 1, of the Niagara Falls Power Co., between 9 and 10 o'clock on the morning of Thursday, February 23rd, causing the death of at least one man, and burning two others in a very serious manner, while it also caused damage of several thousand dollars to the installation. At the time of the accident Roy Robinson and Frank Frommert were in the switch chamber and cable subway changing the connections between a 2,300-volt transformer and a small transformer used for lighting purposes. John Frommert, who was in charge of the other two men, had just entered the switch chamber when the short circuit occurred. There was a tremendous explosion, the greatest yet experienced in the Niagara power development. The insulation of the adjacent conductors took fire and the flames spread to the cables beneath the switchboard. Other employés of the company near by were quick to make efforts to extinguish the fire, and used powder and chemicals, but these did not stop the progress of the blaze started by the short circuit, and it was necessary to call the city fire department. The firemen exhausted their chemical tanks and then ran two lines of hose into the power house, finally conquering the fire, but not before quite a quantity of cable had been destroyed, the insulation burning fiercely. The auxiliary wiring leading to the instruments and field rheostats was practically destroyed, temporarily rendering inoperative the five 5,000-H.P. generators controlled from this switchboard. As soon as possible, which was within a few hours, the load normally carried by these five machines was transferred to other machines, a performance made possible by the fact that at present the total load carried by the company is about 80,000 H.P., whereas its machines can generate 105,000 H.P. The trolley service in the city of Niagara Falls was interrupted for an hour and a half, while the long-distance load was off for about twenty minutes. In fact, this service was resumed before the fire was out. Naturally, the electrical engineers of the Niagara Falls Power Co. have given much time to a thorough investigation of the conditions that developed the short circuit, and it is their opinion that two or three errors were made in forming the new connections, and that had either one of the mistakes been avoided the short circuit would not have occurred."

**Economy of Small Coal.**—The question of using small grades of anthracite is discussed by Mr. Percival Robert Moses in the *Engineering Magazine*. Fuel cost varies from two to three fifths of the total costs of power, the next item being labour. Coal varies in price according to the ease with which it can be employed, and by no means in accordance with its calorific capacity. Every attention is given to the use of steam, little to its manufacture, and the burning of coal is left to haphazard in America, very much as here. Indeed, in a recent discussion on fuel economy, one speaker informed the audience that he employed his firemen as testing chemists, thereby we may suppose expressing his opinion of the value of scientific endeavour; but he was at least consistent, for he also allowed his engine stop valves to remain in a leaking condition in order to keep his engines warm.

Since about 30 per cent. of fuel value goes up the chimney, the maximum saving possible at that point would hardly exceed 15 per cent., or half the chimney heat at the very outside.

We may double the efficiency of a simple pump and only decrease the loss it makes from 99 to 98 per cent. of the heat value consumed; but doubling the heat units of a unit cost of coal will reduce the loss 50 per cent. Therefore while the author would not advise any carelessness of maintenance, he puts forward the claims of cheap fuel. Now, No. 3 Buckwheat coal has 90 per cent. of the heat value of No. 1, or Pea coal. The No. 1 coals cost $2 55 per ton in New York; the smaller coals cost about $2.25, so that the use of the latter means a dollar per ton saved. Surely the author must have made an error in the price of No. 1, which probably he meant to write $3.55. Actually, he says 60 cents per ton may be saved after paying for forced draught, &c.

In a table of price and heat values he finds that for one dollar he can buy 6,400,000 B.Th.U. in Pea coal, and 9,120,000 in Buckwheat No. 3 coal, but after allowing for extra draught, the relative values are 72·7 : 100 for fan draught and 76 : 100 for steam blown draught. To burn the small coals a draught of 1 oz. is necessary, and special grates are required, one type heavy with small openings, the other as open as possible. The chief point is that grates must be larger, and this may be stated almost as an axiom for other small coals as well as for anthracite; this points to one of the advantages of externally-fired boilers, which are not limited as regards their grate area so rigidly as are internally-fired boilers. Obviously, the actual cost for coal per 1,000 thermal units must be worked out up to the point where the ashes are finally disposed of. The report of the Coal Commission shows how much coal is wasted, and the advantages of spending money on washing dirty coal before it is carried. The ability to use small coal, if available at no enhanced cost or inconvenience, would at once place it on a level, as regards price, with the larger sizes. Seeing that coal is cheaper when small, the general statement may be made that the best coal for any particular case is that which will burn on the available grate surface in sufficient quantity to raise the steam required without enhancing labour costs.

## OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

**Central Station Engineers.**—Mr. A. V. Wardrop, of the York Corporation Electricity Works staff, has been presented with a timepiece on leaving to become chief electrical engineer at Elland, under the U.D.C.

The officials and employés at the Rotherham Corporation Electricity Works have presented a case of drawing instruments and a framed photograph of the Electricity Works staff to Mr. R. Jones, station superintendent, who left on 22nd inst. for Southend-on-Sea. Mr. E. Cross, the borough electrical engineer, made the presentation. Mr. Jones also received a silver match box from Alderman D. L. Winter, J.P., chairman of the E.L. and Tramways Committee

**Tramway Officials.** — The Tramways Committee of Salford T.C. has recommended the appointment of Mr. Geo. W. Holford as manager of the tramways. Mr. Holford is chief assistant, and has been under the Salford Corporation for over 18 years. His commencing salary is £300 a year, rising annually by £50 to £500. Mr. Ernest Hatton leaves on 31st inst. to take up his duties at Newcastle-on-Tyne.

Mr. Wm. Grant, who is resigning the post of manager of the Rotherham Corporation Tramways for a similar position at Ayr, has been presented with a silver tea and coffee service, with waiter, by the officials and staff of the undertaking.

Out of 60 applicants for the post of tramway manager at Southampton, the following have been selected to attend before the Committee:—Mr. C. R. Everson, general manager of the Plymouth Corporation Tramways; Mr. R. C. Bullough, general manager and engineer of the Colchester Corporation Tramways; Mr. H. E. Yerbury, chief electrical engineer and deputy manager of the Sheffield Corporation Tramways.

**General.**—We regret to learn that Prof. Sir James Dewar is suffering from a severe attack of gastritis.

Mr. Arnold G. Hansard, consulting electrical engineer, of 53, Victoria Street, S.W., has recently taken into partnership Mr. Henry S. Watson. The style of the firm will be Hansard and Watson. Mr. Watson, who has taken an engineering degree at Cambridge, has had experience of large power schemes, and latterly, whilst with the British Westinghouse Co., he has undertaken the equipment of factories, shipbuilding yards, and blast furnaces for motor driving as his special branch.

Mr. Hilliard Stephens, of 39, Victoria Street, has severed his connection with Mackenzie Bros., and has been appointed sole London agent (engineering section) to the Falkirk Iron Co., Falkirk, N.B. All communications are to be addressed to 39, Victoria Street, S.W.

Mr. W. H. Booth has moved his office from No. 2 to No. 25 (ground floor) Queen Anne's Gate, Westminster.

Mr. S. Thomas Pemberton, the Midland Counties and South Wales representative of Electromotors, Ltd., asks us to announce that he has entirely recovered from his recent serious operation, and, after a three weeks' stay at Bournemouth, will resume his duties on April 3rd.

Mr. R. H. Roberts has been appointed by Marylebone Borough Council inspector of electric cable trench re-instatement work.

Mr. John R. Dick, having completed the term of his agreement as one of the managing directors of the Reason Manufacturing Co., Ltd., has decided to retire from the board at the forthcoming general meeting of the company on April 10th.

We understand that Mr. Wright, the consulting electrical engineer, has informed the Marylebone Electricity Supply Committee that he has recently become a direct shareholder in the Reason Manufacturing Co., Ltd., and that in all probability he will shortly be made a director.

Mr. O. J. Steinhart and Mr. J. L. F. Vogel, hitherto working as Steinhart & Vogel, at 91, Blackfriars Road, London, S.E., as technical chemists and metallurgists, and also as managing directors of the Tungsten and Rare Metals Co., Ltd., announce that they have entered into an arrangement with Mr. T. C. Cloud, late manager of the Wallaroo Smelting Works, South Australia, to amalgamate their businesses, and in future the joint firm will be Steinhart, Vogel and Cloud. Their office will be at 4, Lloyd's Avenue, Fenchurch Street, E.C. (to which all communications should be addressed), and their laboratory and works at Highfield Works, Feltham, Middlesex. Messrs. Steinhart, Vogel & Cloud, will undertake all kinds of metallurgical, chemical and electrical work.

Mr. G. C. Donovan, M.I.E.E, has resigned his position with Messrs. Veritys, of Aston, Birmingham. Mr. Donovan joined that company in January, 1897, as assistant works manager, and the following year was appointed works manager over all Messrs. Veritys' electric departments, including motors, switchboards and arc lamps. That position he held until the end of 1903, when he was appointed business manager to Victoria Works, which office he has now resigned. Last week Mr. Donovan was presented with a handsome roll-top desk by the staff as a token of their esteem and goodwill.

We are pleased to note that Capt. Reginald J. Wallis-Jones, of the 1st Monmouthshire R.G.A.V., has been elected a member of the Council of the National Artillery Association.

## NEW COMPANIES REGISTERED.

**British Automobile Development Co., Ltd.** (84,013).—This company was registered on March 24th, with a capital of £100,000 in £10 shares (5,000 preference), to carry on the business of engineers, manufacturers of motors, motor lorries, motor cycles, traction and other engines, locomotives, road rollers, automobiles, &c., whether propelled by gas, oil, steam, electricity, compressed air or other motive power, wagon, coach and truck builders, iron-founders, tool-makers, brass-finishers, wheelwrights, cycle-makers, carriers of passengers and goods, dealers in railway, tramway, electrical and other apparatus and accessories, &c. The first subscribers (each with one share) are:—E. Garcke, Donington House, Norfolk Street, W.C., managing director; W. L. Madgen, Victoria Works, Belvedere Road, S.E., electrical engineer; C. H. Dade, Donington House, Norfolk Street, Strand, W.C., secretary; H. S. Day, 5, Sutherland Place, Bayswater, W., gentleman; W. J. Greer, 58, South Eaton Place, S.W., company director; S. A. Sillem, The Cottage, Cranes Park, Surbiton, director; and T. Bower, Donington House, Norfolk Street, W.C., clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, one share; remuneration, £50 each per annum, and 5 per cent. of the distributed profits, divisible. Registered office, Donington House, Norfolk Street, W.C.

**S. C. C. Syndicate, Ltd.** (83,996).—This company was registered on March 22nd, with a capital of £50 in 1s. shares, to acquire and deal with patents, rights, designs, secret processes, trade marks, licences, concessions and the like, to develop and turn to account the same, and to carry on the business of financiers, company promoters, bankers, underwriters, concessionaires, contractors for public and other works, &c. The first subscribers (each with one share) are: Sherard Cowper-Coles, Artillery Mansions, Victoria Street, Westminster, metallurgist; H. F. Mitchell, 29 and 30, Broad Street Avenue, E.C., merchant; Lieut.-Col. A. G. Thompson, 18, Prince of Wales Terrace, Kensington; J. Crowther, 29 and 30, Broad Street Avenue, E.C., merchant; G. W. Tunzelmann, 82, Victoria Street, S.W., consulting engineer; B. H. Rolfe, Queen Anne's Chambers, Westminster, consulting engineer; and C. F. Lupson, 272, Upland Road, Dulwich, S.E., registrar. No initial public issue. The subscribers are to appoint the first directors. Registered office, 29 and 30, Broad Street Avenue, E.C.

**Electro-Medical Supply Co., Ltd.** (83,985).—This company was registered on March 22nd, with a capital of £6,000 in £1 shares, to acquire the business of manufacturers of electrical medical battery apparatus and accessories, &c., carried on by J. Richert, E. I. Pronk and A. E. Davis at 29, Harp Lane, Great Tower Street, E.C., as "J. Richert & Co." to adopt an agreement with the said vendors, and to carry on the said business in all its branches. The first subscribers (each with one share) are:—J. Richert, 44, Cambridge Street, Hyde Park Square, W., medical electrician; E. I. Pronk, 29, Harp Lane, Great Tower Street, E.C., merchant; A. E. Davies, 29, Harp Lane, Great Tower Street, E.C., merchant; A. C. Smith, 17, Cambridge Street, Hyde Park, grocer; H. E. Wilkinson, 13, Baronsfield Road, Twickenham, agent; S. C. Mitchell, Sefton, Langley Road, Watford, Herts, salesman; and F. Terry, Maple Cottage, Pendle Road, Streatham, S.W., managing clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are J. Richert, E. I. Pronk and A. E. Davis. Qualification, £100; remuneration as fixed by the company. Registered office, 61, New Cavendish Street, London.

**Electric Ignition Co., Ltd.** (83,984).—This company was registered on March 22nd, with a capital of £10,000 in £1 shares (£5,000 preference) to acquire the business carried on by Constance Hall as the "Electric Ignition Co.," and to carry on the business of manufacturers of appliances of all kinds for electric ignition of internal combustion engines, manufacturers of electrical and mechanical appliances, electricians, workers of and dealers in electricity, engineers, founders, &c. The first subscribers (each with one share) are:—R. F. Hall, 45, Church Road, Moseley, Birmingham, manufacturer; Constance Hall, 45, Church Road, Moseley, Birmingham; F. H. Hall, 45, Church Road, Moseley, Birmingham, engineer; G. N. Hall, Ferndale, Church Road, Moseley, Birmingham, engineer; H. Lewis, Langleigh, Olton, Warwickshire, manufacturer; Mrs. E. Lewis, Langleigh, Olton, Warwickshire; J. W. Lewis, 37, Osborn Road, Sparkbrook, Birmingham, clerk: and E. B. Harker, 344, Marsh Lane, Erdington, Warwickshire, clerk. No initial public issue. The number of directors is to be two; the first are R. F. Hall and H. Lewis; qualification of permanent directors, £500; of ordinary directors, £250. Remuneration as fixed by the company. Registered office, Royal Wellington Works, Sampson Road North, Birmingham.

**Mexican Power Development Syndicate, Ltd.** (83 992).—This company was registered on March 22nd, with a capital of £5,025 in 5,000 "A" shares of £1 each, and 1,000 "B" shares of 6d. each, to construct, control and manage in Mexico or elsewhere, electric, steam, and other railways and tramways, electric storage, power and lighting works, &c., and to carry on the business of carriers of passengers and goods, electrical engineers, electricians, manufacturers and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, &c. The first subscribers (each with one "A" share) are:—C. G. West, 136, New Cross Road, S.E., clerk; H. L. Bankes, 33, Cornhill, E.C., clerk; H. T. Holmes, 166, Wilmot Street, Bethnal Green, book-keeper; H. J. Pexton, Kildare, Honor Oak Park, S.E., clerk; J. Roney, 33, Cornhill, E.C., secretary; L. Fishwick, Basildon House, Moorgate Street, E.C., secretary; and T. H. Firth, 9, Challoner Mansions, West Kensington, W., clerk. No initial public issue. The number of directors is not to be less than three nor more than nine; the subscribers are to appoint the first. Qualification, £100; remuneration £100 each per annum (chairman £150), and 5 per cent. of the distributed profits, divisible. Registered office, Basildon House, Moorgate Street, E.C.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Malaga Electricity Co., Ltd.** (48,076).—Re-issue, on February 14th, of £16,034 debentures, part of series created by resolutions of March 29th, 1897, February 7th and 28th, 1898, and October 13th and 20th, 1899, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital and the electrical station at Malaga. No trustees. Previously issued of same series: £44,738.

**I. Frankenburg & Sons, Ltd.** (67,889).—This company's annual return was filed on March 1st, when 10,093 ordinary and 10,010 preference shares had been taken up out of a nominal capital of £250,000 in £10 shares (12,500 ordinary and 12,500 preference). £10 per share has been called up on 593 ordinary and 10 preference shares, resulting in the receipt of £6,030. 9,500 ordinary and 10,000 preference shares are considered as fully paid. Mortgages and charges: Nil.

**Herberlein Co., Ltd., mechanical and electrical engineers,** London (80,193).—Issue, on February 23rd, of £1,280 debentures, part of series created February 29th, 1904, to secure £2,500, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

**Electrolytic Alkali Co., Ltd., Middlewich** (64,360).—Issue, on March 1st, of £3,750 first mortgage debentures, part of series created July 9th, 1904, to secure £50,000, charged on the company's undertaking and property, including uncalled capital. Trustees: Liverpool Mortgage Insurance Co., Ltd., 6, Castle Street, Liverpool. Previously issued of same series: £13,750.

**Central Electric Supply Co., Ltd.** (53,080).—An acknowledgement of indebtedness under seal, dated March 6th, 1905, creating £50,000 further debenture stock (making, with £300,000 already created, a total of £350,000 debenture stock, and being supplemental to a trust deed dated July 2nd, 1901, securing not more than £500,000), and an instrument of charge of even date under the Land Transfer Acts, 1875 and 1897, securing £55,000 with respect to the issue of the said £50,000 stock, have been registered. Property charged: Part of the land in Marylebone comprised in Title 44,393. Trustees: Hon. A. Lyttleton, K.C., 3, Paper Buildings, Temple; and W. H. Fisher, M.P., 13, Buckingham Palace Gardens, S.W.

**Direct Spanish Telegraph Co., Ltd.** (6,732).—£20,000 4½ per cent. debentures, created by board resolution of February 21st, 1905, have been registered. Property charged: The company's undertaking and property, present and future. No trustees.

**Eastern Telegraph Co., Ltd.** (6,338 C).—This company's annual return, made up to February 8th, has been filed. £5,999,890 stock has been taken up out of a nominal capital of £6,000,000 in £4,000,000 ordinary and £2,000,000 preferred stock. £5,999,890 has been paid. Mortgages and charges: £1,887,704.

**Electric Canal Haulage Co., Ltd.** (60,462).—This company's annual return was filed on February 27th, when 7 shares had been taken up out of a nominal capital of £8,000 in £1 shares, and £7 has been received. Mortgages and charges: Nil.

# CITY NOTES.

## Bruce Peebles & Co.

The report of the directors, which is to be submitted to the shareholders at the second annual general meeting to be held at East Pilton, Edinburgh, to-day, shows that the net profit for the year 1904 amounted to £28,792, plus £354, the balance brought forward = £29,146. After paying preference dividend, the directors recommend a dividend of 6 per cent. per annum on the ordinary shares, requiring £5,706, placing to the preference shareholders' special reserve fund (not less than 10 per cent. of the net profits), £2,879; writing off preliminary expenses, £4,000; general reserve fund (thereby increasing it to £8,000), £7,000; and carrying forward £3,854.

The new works at East Pilton were completed in February, 1904, and although considerable dislocation in manufacturing and heavy expenses were caused by the removal from the old works, the change has been very beneficial, the full effect of which has not been reflected in the accounts under review. The entire expenses connected with the removal have been charged to revenue. The cost of the works stated in the original prospectus was estimated at £53,000, but, owing to the expansion of the business and the necessity of providing larger and more highly specialised plant to increase the capacity, the total expenditure under this head has been £98,000. The works are now equipped to deal with a large output in a thoroughly efficient manner. During the year under review, in consequence of the additional capital expenditure on buildings and plant and the increase in the business, the directors have exercised their powers of creating and issuing debentures for £50,000, bearing interest at 5 per cent. per annum. The turnover for the past year has been more than double that of the previous year, and the orders on the books of the company at the close of the year considerably exceed in amount those of the previous year. The company have also several large profitable contracts on hand for power and traction companies. The debentures and shares in power and traction companies, acquired by the company in part payment of certain contracts, have been valued by the directors considerably under par, and they believe the valuation to be reasonable. Owing to the considerable increase in the business of the company, it is necessary and desirable that further capital should be raised. The shareholders will, therefore, be asked to sanction the creation of 10,000 additional preference shares of £5 each, and 10,000 additional ordinary shares of £5 each, and to increase the borrowing powers to the extent of £50,000. The further share capital will be issued as soon as possible, but it is not intended to exercise the new borrowing powers meantime.

## Melton Mowbray Electric Light Co.

The annual meeting of this company was held on Monday, Mr. W. J. New presiding. The directors, in their fifth annual report, stated that the number of lamps had increased 22 per cent., the number of consumers now totalling 469. The public lighting contract with the local authority had again been secured for a further period of five years. The revenue for the year, including a balance of £160 brought forward, amounted to £1,376, which, after the payment of debenture and loan interest and battery renewal charges, totalling £871, left a balance of £504. The directors recommended a dividend of 2½ per cent. per annum, leaving a balance of £103 to be carried forward.—The report was adopted.

## National Electric Construction Co.

Mr. R. Stewart Bain presided at the annual meeting held last Friday at Winchester House. In moving the adoption of the report, he said that at the last meeting he had to regret a loss of nearly £4,000, but he expressed a hope that there would be a more favourable account to give this year, as they had several contracts in hand which they had every reason to believe would result in substantial profits. The contracts mentioned were those of Carnarvon, Holyhead, Bo'ness, Kildare, and the Musselburgh lighting and tramway order. The whole of these had now been completed, and the result was, that instead of the profit and loss account showing a loss, it showed a very substantial profit of nearly £20,000. The Musselburgh tramways were opened in December last, and they were of opinion that this undertaking would become a valuable property. The Holyhead and Kildare contracts were completed last year to the satisfaction of the local authorities. The Bo'ness and Carnarvon undertakings were opened last month, and applications received for current were satisfactory. He mentioned last year that they had also concluded contracts with Paignton, Wisbech and Basingstoke, and since then they had completed an agreement with Ormskirk. The L.G.B. inquiries had taken place at Basingstoke and Ormskirk, but they could not proceed with the contracts until the consent had been obtained. The revenue from free wired installations showed a decrease. This was explained by the fact that they had sold a number of installations to the local authorities or companies with whom they had contracts. The profit on contracts completed and in progress had increased from £853 last year to £25,933 this year, that being the result of the various contracts mentioned. The reserve and depreciation allocations were £10,111 as compared with £3,254 last year. The debit side of the account included a mortgage of £8,000, which they hoped to be able to pay off very soon. They had made a commencement with a reserve account (£500). The amount due to sundry creditors was large, as was to be expected from the great amount of work they had in hand at the end of the year, but some £20,000 of that sum had been paid off up to date. They had made a commencement at writing down the purchase of the business, and this would be increased as funds permitted. The free-wiring installations had decreased from £50,817 to £40,521 as the result of the sales mentioned. They had written off a further £3,069 for depreciation, as they thought it prudent. The contracts in course of completion were this year £49,000 as against £13,000 last year. The board were satisfied that the £49,050 invested in the Musselburgh Construction Syndicate was worth a considerable premium. After further reference to the accounts, the chairman said that the future prospects of the company were distinctly favourable. In addition to the contracts already mentioned as awaiting the L.G.B.'s decision, they had just concluded two agreements, one for laying down an electric tramway in a town on the South Coast, and the other for taking over an electric lighting and tramway order in the Midlands, both of which they had every reason to believe would be very profitable; they would occupy the company for at least the next 18 months. They also proposed to apply for powers for extension of the Musselburgh and district tramways along the coast, and they had applied for powers for making a new tramway between Edinburgh and Queensferry. The future of the company was very bright, and he congratulated the shareholders upon the change that had taken place during the year.

The report was adopted.

Resolutions were passed approving the dividends of 6 per cent. on the shares, and 1½ per cent. on the vendors' shares; also re-electing directors and auditors, and thanking the chairman and staff.

## Swansea Improvements and Tramways Co.

The meeting of this company was held at Donington House on March 23rd, Mr. C. G. Tregetmeier presiding. He said that so far as the light railway extensions were concerned, the company was under no obligation to take them over until they were all completed. He was afraid the lines would remain unused, and the Corporation expenditure unproductive for probably many months to come. There was a portion of the extensions that could not be completed for some time. When that completion had been effected there would, he expected, be several debatable points as to the amount of the price; in other words, as to the "capital properly expended" on the construction of the lines. The company had informed the Corporation that on certain conditions they were prepared to take over and work the completed portions of the line as soon as they were ready for traffic, leaving the question of the amount on which rental was to be paid for future settlement. If the Corporation agreed, the completed portions would probably be opened in the next few weeks. A portion of the arrangement in connection with the light railway extensions was, that the company should take from the Corporation the electrical energy for the working of the whole of the Morriston section of the company's line as well as the Corporation extension, and that the Corporation should buy from the company the electrical equipment installed on the company's portion. It had been agreed that the price for the latter item should be £6,641 10s. A satisfactory arrangement had also been made with the Corporation for the electrical energy which it was to supply the company.

## Greenock and Port Glasgow Tramways Co.

The report for the year 1904 states that the outlay on the electrical construction account during the period amounted to £5,365, and that £3,787 had been debited for material transferred from outlays on old lines, making the total expenditure to December 31st last £186,034 11s. 4d. The total revenue for the year was £30,583, and the expenditure £21,359, which sum included interest rentals payable to corporation, cost of repairs and maintenance, and a provision of £1,500 for depreciation and renewals, leaving a profit of £9,224. To this had to be added £2,093 brought forward from last account, making a total of £11,318. The directors recommend as follows:—For the reserve sinking fund, £1,780; dividend at the rate of 5 per cent. per annum on the preference shares, £3,500; dividend at the rate of 4 per cent. per annum on the ordinary shares, £4,600; balance to be carried forward, £1,437. The reserve sinking fund will then stand at £5,448. The claim in respect of profits by the Greenock Corporation was inquired into in November last by the inquirer appointed by the Board of Trade, whose report had since been made, recommending the Board of Trade to award the sum of £602 18s. 9d. as due to the Corporation to December 31st, 1902. The directors, however, took exception to certain parts of the report, and had requested the Board of Trade to state a case for the decision of the High Court on points of law. Six additional cars had been purchased during the year, making a total of 36. The number of passengers carried during the year was 6,644,388, as compared with 6,200,778 in 1903. The average receipts per passenger were 1·08d., as against 1·13d. the previous year. The average working expenditure per passenger (apart from rentals, &c.) was ·62d. against ·57d.

## Browett, Lindley & Co.

The report for the year 1904 states that owing to depression in the engineering trade the works have been only partially employed during the past year; the output being less than half the amount of that for 1903. A gross profit has been made upon completed work of £5,394, but out of this the sum of £5,272 has been spent in meeting expenses in connection with guarantees over extended periods, and a considerable amount was due to an old type of governor, which has now been abandoned. Further reserves have been made against any contingencies of a similar kind, and it is hoped that the loss under these heads has now been covered. An increased amount has been written off for depreciation, the total sum being £6,428. The cost of repairs has been charged to revenue.

The net result of the year's operations is a loss of £14,850, to which must be added £3,993, making a total of £18,848. Several changes in the management of the company have taken place since the last annual meeting, and in the following order:—On June 30th, 1904, Mr. W. Stead's connection with the company was terminated; on July 5th, 1904, at the invitation of all the remaining directors, Mr. Walter Browett rejoined the board; and on August 17th, 1904, Mr. F. C. Gibbons resumed his connection with the company, having been unanimously appointed sole managing director. Since Mr. Gibbons took up his duties, alterations have been made in the *personnel* of the staff, which are proving beneficial. Although the depression in trade continues, there appear indications of a general improvement in the near future. The directors consider the company is handicapped by being builders of high-speed engines only, and have under consideration the manufacture of other types, for which they have already received inquiries. It is hoped such additional work will have the effect of increasing the output, which the works are well equipped to deal with economically.

## Great Northern Telegraph Co. of Copenhagen.

The directors announce that, according to an approximate computation of the receipts and expenditure for 1904, the net receipts amount to £480,000, which the board of directors will propose to distribute about as follows:—

| | |
|---|---|
| Reserve and renewal fund .. .. .. .. .. .. | £56,000 |
| Pension fund of staff .. .. .. .. .. .. .. | 8,000 |
| Remuneration to board of directors .. .. .. .. .. | 2,500 |
| Dividend equalisation fund .. .. .. .. .. .. | 53,500 |
| Dividend and bonus of 24 per cent. (5 per cent. of which has already been paid) .. .. .. .. .. .. .. | 360,000 |
| | £480,000 |

Whilst the amount carried forward to 1905 will be about the same as was carried forward from 1903 to 1904.

## British Insulated and Helsby Cables Co.

The annual meeting was held at Liverpool on 27th inst., Mr. E. K. Muspratt presiding, and in moving the adoption of the report, he said that, having regard to the continued keen competition experienced during the year, the report would be regarded as satisfactory, especially when it was known that the price of rubber had further increased, while the selling price of this class of goods had remained unaltered. The company continued to do a satisfactory business with all its best customers, including the great corporations and Government departments, and during the year it had begun and completed one of the largest contracts ever placed in this country for cables—namely, that with the Underground Electric Railways Co. of London. Referring to the future, the Chairman remarked (says the *Financial Times* report) that, owing to various causes, there appeared to have been less inducement to municipalities to lay out capital in electrical undertakings, and there had not been much activity in the promotion of companies for electrical purposes. That, however, was gradually passing away; money was easier, and the country, he thought, was generally recovering its prosperity, and he trusted that before long activity would be shown in electrical development throughout the country.

Mr. Crane asked why nothing had been written off the patents and goodwill accounts, which he regarded as the most intangible of all their assets.

The Chairman stated that patents and goodwill figured in the assets at £246,133. He would be very glad to see the whole thing struck out, and very glad to see machinery depreciated even to a greater extent; but they could only deal with their earnings.

Mr. Menzies asked whether the £129,000 in the profit and loss account included any profit on investments.

Mr. Barber said it included interest received on investments undoubtedly, but not profits on realisation of investments. When they sold their Australian interests they hoped to make a profit, and they would show it in the balance-sheet; but they were very careful not to anticipate. The greater part of the £129,000 was profit on trading.

The report was adopted.

## Perth Electric Tramways, Ltd.

Mr. R. C. Ogilvie presided at the annual meeting held in London on March 23rd. He congratulated shareholders upon the progress of the business, the gross receipts having increased by £7,000, of which nearly £6,000 was net profit. The general prospects of traffic for the current year were very promising, the increase up to March 17th being £1,280. The whole system under the original concession had now been completed, and some advantageous modifications with regard to the original routes had been made, with the consent of the authorities, which would, it was hoped, still further increase the earning powers of the company. With regard to the probable effect of the competition of motor-'buses, those best qualified to judge were of opinion that motor-'buses could not successfully compete with well-organised electrical tramway systems, although under certain conditions they must become very valuable "feeders." So far as Perth was concerned, although three motor-'buses had been introduced, this company's traffic continued to increase. The board were seriously considering whether it might not be desirable for a suburban company to undertake future extensions, in order both to relieve this company from having to use its present profits for the purpose, and also to enable the inhabitants of the different suburbs who needed the extensions to contribute towards the capital of the proposed company and participate in the profits. The directors hoped that at the end of the present year they would not only be in a position to add still further to the reserve, but would at the same time be able to seriously consider the question of a dividend on the ordinary share capital. The concession under which the tramways were worked was terminable, and it was highly desirable, in the interests of the holders of both classes of shares, to establish a fund which should be available at the end of the term for refunding the share capital at the expiration of the concession, in about 35 years from December last. Should the very satisfactory rate of progress continue, the provision of such a fund should be made without unduly interfering with the distribution of the profits. The board recorded their appreciation of the services of Mr. Somerset and his staff in Western Australia.

## Willans & Robinson.

The half-yearly report to be submitted at the meeting at Cannon Street Hotel, on Wednesday, April 5th, reads as follows:—

"The directors regret to say that the operations of the company during the half-year have resulted in a loss, as regards the Rugby business, of £19,895, and, as regards Queen's Ferry, of £22,877, or £42,772 in all. It is right to point out, however, that £18,954 represents depreciation, and that £5,127 represents the valuing down of sundry stocks, &c, not arising directly out of the half-year's work. The total of these sums, £24,081, is in the nature of a "book" loss and does not represent actual diminution of the liquid assets of the company. As the debit balance brought forward amounted to £37,180, there is now a debit balance on the profit and loss account of £79,952. An endeavour has been made, in accordance with a wish expressed by shareholders at the last meeting, to apportion certain expenses between Rugby and Queen's Ferry. In some respects it has only been possible to do this by estimation. The directors have thought it right to exercise fully as great prudence in the matter of depreciation as in the times when the affairs of the company were most prosperous. The extremely unfavourable trade conditions of the past year, leading to a reduction in prices unprecedented in the history of the company, have resulted in a heavy loss, even in the engine-building section of the business. The directors are, however, glad to say that the steam turbine business is developing rapidly and promises to become a valuable speciality. A friendly arrangement has been entered into with Messrs. C. A. Parsons & Co., and the company has taken a licence enabling it to work under the patents of the Hon. C. A. Parsons. The company has also valuable patents of its own under which it will continue to work. As regards Queen's Ferry, the attempt to find a purchaser for the business, or even for the works, has had no success, as, in the present state of the trade, was perhaps to be expected. Work was necessarily carried on during the half-year, though under very great disadvantages, in order to complete existing contracts for boilers. Repeat orders, upon satisfactory terms, having resulted, the directors propose to continue the manufacture of tubes and boilers upon the present modest scale, in the hope that the business will grow to be self-supporting. This result may be contributed to by the steel manufacture, which, after being abandoned in May, 1904, was restarted at the beginning of the now current half-year, with every prospect, so far as can be judged at present, of proving profitable. The directors are satisfied that it is better, under present circumstances, to run the Queen's Ferry Works than to close them. The directors regret to say that Mr. T. O. Lazenby retired from the board last autumn on account of ill-health. The vacancy has not been filled and the board propose that the number of directors, raised last year to seven, be reduced to five, as before. Notice is given of a resolution to this effect. Mr. Robinson and Captain Sankey retire by rotation. Captain Sankey does not offer himself for re-election; Mr. Robinson is eligible and offers himself for re-election.

## Slough and Datchet Electrical Supply Co.

The second annual meeting was held at Chalvey recently, Mr. Tonman Mosley presiding.

The report showed that the capacity of the generating station was now 870 H.P. as compared with 510 H.P. last year, and the order had been given for an additional boiler of 500 H.P. The capital expended during the year was £7,729 18s., bringing the total up to £38,982 7s. 7d. The directors have found it necessary to issue the remaining share capital, amounting to £15,000. During the year the equivalent of 2,482 8-C.P. lamps were added, bringing the total up to 5,608, of which 198 represented the motor power. The total revenue for the year was £3,011, including the sale of current in bulk to the Windsor Co., which amounted to £1,452. The directors recommended the declaration of a dividend at the rate of 3 per cent. per annum (£1,050), leaving £578 to be carried forward. Under the articles of association, two of the directors retire, and it has been arranged that Messrs. Tonman Mosley and A. A. Somerville should do so on this occasion, but, being eligible, they offer themselves for re-election.

The Chairman, in moving the adoption of the report, said he did not think there were many electric light companies of their size, and in districts so far from London, that had declared a dividend at so early a stage at the same rate as was recommended. He was bound to say that a good deal of that was due to the assistance of the Windsor Electrical Installation Co., of which the company was the child, and with which they had a very advantageous agreement. No charge for depreciation had been allowed for this year, as all the buildings and machinery were practically new.

The report was adopted.

## Folkestone Electricity Supply Co.

The report for 1904 states that the equivalent of 8-c.p. lamps supplied had increased from 54,805 to 64,915. The revenue account shows a profit of £9,051, which, with the profits on installation work, &c., and £302 brought forward, and after allowing for interest on debenture stock, dividend on preference shares and bank charges, &c., and carrying £1,700 to depreciation fund, makes a net balance for distribution, after allowing for the interim dividend at the rate of 4 per cent. per annum already paid, of £2,058. The directors recommend a dividend at the rate of 7 per cent. for the half-year (making 5½ per cent. for the year), leaving £309 to carry forward. The sum of £1,557 has been written off in respect of depreciation of accumulators. The whole of the further issue of £25,000 preference shares offered last year, making a total issue of £50,000 preference shares, has now been taken up, and an application is being made to the Stock Exchange for a quotation. It is proposed shortly to make a further issue of 4½ per cent. debenture stock, ranking with the £50,000 first debenture stock already issued.

## Newmarket Electric Light Co.

The annual meeting was held on 20th inst., Mr. G. H. Verrall presiding. During the past year 1,737 8-c.p. lamps were connected, making a total of 18,190 lamps. Applications for a further 728 lamps had been received this year. The profit on the year's working, added to £313 brought forward, amounted to £2,019, which, after providing for debenture interest, £707 0s. 10d., left a balance of £1,312. The directors recommended that a dividend of 4½ per cent be paid, that £250 be carried to reserve, and that £134 be carried forward. The chairman said that the profits for 1904 were less by about £444 than those of 1903, but this was wholly due to the difference in the wiring accounts. In 1903 the company had had a number of very profitable wiring contracts. On account of empty houses in the town, there were about 1,773 lamps which were connected and not in use during February. Mr. Verrall called attention to the Nernst lamp, by which the cost of lighting large buildings was reduced by 40 to 50 per cent., and said that the cost of light at his own residence last year had been 12 per cent. lower than in 1898, when he used gas.

## Bournemouth and Poole Electricity Supply Co.

The eighth ordinary general meeting of the shareholders of this company was held on Thursday of last week, at Moorgate Court, E.C., Mr. A. H. Sanderson in the chair.

The Chairman, in proposing the adoption of the report (see Electrical Review, March 17th. p. 454), said there had been a substantial increase in the gross revenue, in the lamps applied for, and in the units sold. The reserve for depreciation now amounted to £14,365 15s. 4d., being an increase of £3,500, the amount transferred from the premium account last year. The gross receipts had increased from £35,658 6s. 7d. to £40,414 4s. 6d., an increase of £4,755 17s. 11d. On the debit side most of the items showed an increase. It was only natural that there should be an increase in coal and fuel, seeing that there was such a considerable increase in the number of units generated and sold. The repairs had been extremely heavy, and had been brought about largely by the reconstruction works which had been going on at their central station. It was not likely, however, that such a large expenditure would occur again for some time to come, and the current year was certain to see a marked improvement in that respect. It was a matter of regret that they had not been able to write off anything out of revenue for depreciation, but that was due to the fact that so much of the capital expended during the last year had not yet provided an adequate return. Although they proposed to pay 7 per cent., as against 8 per cent. on the ordinary shares, he would like to point out that they required an extra £1,500 to do it. The capital they had expended last year would, he was assured, in due time become quite as remunerative as similar expenditure had in the past. Seeing that they had opened up entirely new areas, they could scarcely expect that those new mains should at this early date give a greater return than they had made during the past year. With regard to the general progress of the company, the lamps applied for and the units sold, the position was in every way satisfactory, and they could again claim a record in both those matters. The increase in the lamps applied for was equivalent to 21,051 8-c.p. lamps, as against 19,542 for 1903. The total number of lamps applied for on December 31st last was 121,589, and the progress made in that direction since the close of the year was equally satisfactory. The units sold during the year in respect of lighting, power and traction amounted to 1,703,229 as against 1,520,002 for 1903, being an increase of 183,227. They had applied to the Board of Trade, with the consent of the local authorities concerned, in the present session of Parliament, for a provisional order for Wimborne and the surrounding areas. Should they be successful in their application, it was their intention to supply those areas from their existing stations in Bourne Valley. They had reached their limit as regarded capital powers, and it was proposed to increase the share capital from £300,000 to £500,000 by the creation of a further 10,000 preference shares of £10 each and a further 10,000 ordinary shares of £10 each. They also proposed to increase their borrowing powers from £150,000 to £300,000. Because they were taking those additional powers, it did not imply that they intended to exercise them at the present time. As a matter of fact, there was no intention to make a further issue during the current year, but, to save the necessity of calling another meeting, they had decided to deal with the question now. He was pleased to say that the Richmond company continued to make progress. The dividend had not been increased, it was true, but the position was much improved, and the figures of the balance-sheet showed all round satisfactory progress. Looking to the whole position they had every confidence in the future of the undertaking. They had 95 miles of roads in their area which were laid by distributing mains, exclusive of feeders, &c. The total number of consumers connected was over 2,000, with a total lamp connection equivalent to 113,573 8-c.p. lamps, and motors with a capacity of 288 h.p. They found that electricity for motors was becoming increasingly popular in Bournemouth, and they had introduced a system of leasing motors out to customers on remunerative terms. The Christchurch tramways, which they would supply, would be in working order shortly, and that would give them a day load.

Dr. J. A. Hosker seconded the motion, and the report was adopted.

Subsequently, resolutions were agreed to authorising an increase of the capital and in the borrowing powers of the company as indicated by the chairman.

## Mersey Railway Co.

The half-yearly meeting of the shareholders of the above company was held on Thursday of last week, at Worcester House, Walbrook, Mr. James Falconer presiding.

The Chairman, in proposing the adoption of the report, said it showed that substantial progress had been made during the half-year, both as regarded the number of passengers carried, and the total receipts. That was very satisfactory, having regard to the fact that in both cases it was a comparison under electric traction. Last half-year they were gratified to find that the receipts then compared very favourably with those of the previous six months, when the railway was working under steam, but it was still more gratifying to find that the increase continued at a greater ratio than that which the first six months under electric traction showed. That proved that the increase was not due to the novelty of the new method of traction, but that the great convenience of the railway was becoming more and more appreciated by people who had to cross from one side of the river Mersey to the other. That was confirmed by an examination of the statistics of the increase. The number of booked passengers had increased by 504,000 in the half-year, while the season ticket receipts had increased by £878, equivalent to an increase of 28 per cent. That he regarded as the most satisfactory feature. The total increase in receipts was £4,431, which was equivalent to 12 per cent., or at the rate of £8,880 per annum, which was a very substantial improvement, having regard to the volume of their general receipts. When they compared the figures with those of the last half-year under steam working, the importance of the change which they had made became more pronounced. As compared with the half-year ending December 31st, 1902, when they were working under steam, the booked passengers had increased by 1,813,000, which was equivalent to an increase of 64 per cent., and the receipts from season tickets had increased by £1,395, equivalent to an increase of 53 per cent. The total revenue from all sources, as compared with the last half-year under steam, had increased by 42 per cent. That increase showed in the most conclusive and striking way that they had adopted the right method of dealing with the problem, and had shown that the verdict of people who were in the habit of journeying between the places which the railway served, was a satisfactory one in favour of their electric system. He fully recognised the long distance they had yet to go before they arrived at the position of getting all the net revenue they had a right to expect. Their working expenses had diminished rather than increased, and even if the revenue were to double itself, the expenses would not be appreciably increased. What they now had to do to make the company a complete success was to cultivate and develop the traffic. As showing the capacity of the railway for dealing with traffic now that it was electrified, it was interesting to look at the returns for the week ending December 24th last, which was an excessively foggy week in Liverpool. While the fog was bad for the country, it was good for their railway, for in that week they carried 260,431 passengers, as against their normal weekly number of 190,000, and their receipts amounted to £2,431, as against average earnings of £1,600. The whole of that traffic was quite conveniently accommodated, and no strain was experienced by the staff in dealing with it. That showed that there was an elasticity about their system which rendered it capable of dealing with any amount of traffic which might come along. With a view of inducing more people to travel first class, they had reduced the fares. Their difficulty was that their third class was so good that people did not seem to appreciate as largely as they would like them to, the extra accommodation which they provided in the first class, but the directors were convinced that they were on the right lines in having two classes, and that there was a profitable business to be done in catering for first-class passengers.

Mr. S. Gurney Sheppard seconded the motion, which, after some discussion, was adopted.

Mr. R. St. Clare Parsons, in proposing a resolution awarding the chairman £5,000 for special service rendered in connection with the work involved in changing the railway from steam to electric traction, said that the transformation had entailed an immense amount of personal work on the chairman, as that was the first ordinary gauge railway in this country which had been electrified.

It was true that the ordinary shareholders had not at present reaped any special benefit by the conversion, but it was merely a question of time.

Mr. Gurney Sheppard seconded the resolution, which was supported by a shareholder, and carried unanimously.

## W. T. Glover & Co.

The report for 1904 states that the amount standing to credit of profit and loss account is £7,976, after adding £3,649 to reserve fund. The demand for goods of the classes manufactured by the company (especially those for home consumption) has not shown any improvement during the period under review, but rather the reverse. The general financial position of the company has improved, but the comparatively small demand above mentioned, and the severe competition existing, render it necessary for the directors to pursue a cautious policy. Accordingly they regret they do not yet feel justified in recommending the payment of a dividend. There is an increase in the item under the heading of investments due to payments made during the year, to which the company was previously committed, and not to any extension of investments. The company's rights and easements, which were affected by the Bills promoted during the past year by the Trafford Park Estates, Ltd., and the Stretford Urban District Council, have been satisfactorily protected, and the various points of contention amicably settled. A fund, as authorised at the last general meeting, has been created to indemnify the directors standing from time to time as guarantors for the fulfilment of the company's contracts.

## Bromley (Kent) Electric Light and Power Co.

The directors report that the progress made by the company during 1904 was satisfactory, the lamp connections having increased from 47,030 to 56,198. The sale of current increased from £9,843 to £11,366. The works have been maintained in good order and repair, and during the year considerable additions have again been made to the generating plant and mains to meet the increased demand. The result of the year's trading, including the balance of £35 brought forward, and after allowing for bad and doubtful debts, shows a profit of £8,286, and after payment of debenture and loan interest, &c., amounting to £2,527, the amount available for dividend is £5,759. An interim dividend at the rate of 4 per cent. per annum was paid for the half-year in October, and the directors recommend the payment of a further dividend for the last half-year at the rate of 7 per cent. per annum, making 5½ per cent. for the year; that £1,000 be placed to the renewal reserve fund account; and that the expenses in connection with the new issue of capital, amounting to £24, be written off, leaving a balance of £85 11s. 11d, to be carried forward to the next account. During the year £5,000 new debenture stock has been issued and subscribed for.

**Buenos Ayres and Belgrano Electric Tramways Co.**—The report for 1904 states that the total receipts were £171,365, and expenditure £93,452, leaving a balance of £77,913, exclusive of the amount brought forward, £2,479. The following charges have been made to net revenue account:—For debenture stock interest, £25,385; for renewals fund (thereby raising same to £21,000), £5,000; for amount written off capital expenditure, £4,500; to the credit of sinking fund for the redemption of debenture capital, £2,500; to the credit of accidents insurance fund, £500. The 6 per cent. dividend on the "A" and "B" preference shares absorbs £10,250. The directors recommend a balance dividend of 2s. 6d. per share, making 4s. per share, or 4 per cent. per annum, absorbing £20,000, and leaving £2,086 to be carried forward.

**Liverpool District Lighting Co.**—The report for the year ended December 31st last states that the demand for electricity continues to increase satisfactorily, the number of units sold during 1904 being 246,943, as against 187,197 in 1903, and the amount received £5,384, as against £4,213 for 1903. The number of lamps supplied on January 1st, 1905, was 16,517, as against 14,000 in 1903. The directors announce that through a most unfortunate and unprecedented occurrence, bad debts, principally on the contracting business, have made it impossible for them to declare any addition to the 2 per cent. interim dividend paid in August. The small balance of £262 is carried forward.

**Stock Exchange Notices.**—The Committee has appointed Wednesday, April 5th, as a special settling day in Henley's (W. T.) Telegraph Works Co., Ltd., further issue of 5,000 ordinary shares of £5 each, fully paid, Nos. 35,001 to 40,000, and has ordered same to be quoted in the Official List, also British Aluminium Co., Ltd. 20,000 4 per cent. funding certificates of £5 each, Nos. 1 to 20,000.

**Ingersoll-Sergeant Drill Co.**—The report for 1904 shows that a total of £44,864 was received in interest and dividends from the American company. The directors now recommend that a final dividend on the ordinary shares be paid, making 10 per cent. for the year, leaving £14,657 to be carried forward.

**Primitiva Gas and Electric Lighting Co.**—The directors recommend a dividend of 6 per cent. on the ordinary shares.

## STOCKS AND SHARES.

Wednesday Evening.

Langour has taken the place of animation in the Stock Exchange, and markets are suffering from the end-of-the-quarter restraint which generally characterises buyers at such times. Several recent new issues have been rather badly cold-shouldered by the public, thanks to the mad rush of promoters to put all their goods in the window at once, and to demand fairly high prices for them. One might almost doubt whether the Charing Cross or the Great Northern Debenture stocks would be avidly applied for now, had the issues been postponed. The price of both has dropped this week to "par"—*i.e.*, to the price of issue, although it recovered again to about ⅛ premium for the Special Settlement, the date of which will be very shortly fixed. Baker Street and Waterloo Debenture manages to maintain itself well at 2⅜ premium.

With regard to other electrical railway descriptions, City and South London declined ¼ to 44½, but rallied again to 45, while Central Londons have not moved. Metropolitan Consolidated is still 97, and Districts 4½, Great Northern and City Preferred "A" 6¼, and Great Northern and Piccadilly certificates 9; both these two last-named are £10 shares and fully paid. East London settled down to 5½, and Mersey Ordinary to much the same price.

In the traction department, Anglo-Argentine Trams Ordinary rose ⅛ to 8⅞, despite the flabbiness of the Argentine railway market. The Preference are 5⅞. A slight rise in Auckland Debenture makes the middle price 106, in the neighbourhood of which a good deal of business is being done. London United Debenture was bought at 100⅜ the other day; the purchaser might have done better with his money. British Electric Traction First Debenture displays a point improvement, and the Second Debenture holds its 3 per cent. advance of a week ago. North Metropolitan Trams change hands at a fraction under 4, and Cape Electrics show more firmness at 1 9/16. It may be incidentally pointed out that the stock and shares of the two chief omnibus companies are both on the down grade once more. London General Omnibus stock stands at 114½, and Road Car shares at 5⅞. The Road Car Co., of course, recently made a new issue of shares at £6 a piece in order to pay for important extensions in the company's motor-'bus services.

After their sharp recovery, British Westinghouse Preference have fallen back ⅛ to 3⅛, there being no confirmation of the rumour about the Westinghouse amalgamating with the Armstrong-Whitworth Co. The 4 per cent. Debenture stock is 92; British Thomson-Houston 4½ per cent. Debenture commands par. Two contradictory features stand out in the Industrial market. One was a first advance in Babcock & Wilcox shares, the price of which rose to 4⅞, although it has slipped back to 4½. The other is the slump in Willans and Robinson Ordinary to 30s., and in the Preference to 50s., upon the issue of another deplorable report. If the clouds are blackest just before the dawn, then the company should be seeing the sunshine very soon. The 4 per cent. Debenture stock is quoted at the wide range of 75—80.

Only Great Northerns have improved in the Telegraph section, and they rose no less than 3 to 39, or £6 a share jump in a fortnight. The reason is to be found in the almost sensationally good dividend just declared. Other Telegraph descriptions, if not depressed, are certainly dull, in company with investment securities all round the Stock Exchange. Westerns fell ¼ to 14, Eastern Extensions ¼ to 14½, and Anglo "A" a full point to 16, this last on profit-taking by gamblers who had bought lower down. Eastern Telegraph Ordinary moved down 1 per cent., and West India Second Preference shares shaded off to 8¼, and the Ordinary to 7⅛, but the Trust varieties remained firm. Telephone issues also weakened, National Deferred and Preferred stocks losing ½ each, and United River Plate shares ¼, at 104, 110 and 7½ respectively. On balance it will be observed that the changes are very slender.

Somewhat similar remarks apply to the electricity supply group. People are not investing their money on this side of the last day of March, but that markets will recover next month is considered more certain than that Oxford will win the Boat Race. City Lights, Kensington, Metropolitan, Westminster, and St. James's Ordinary, all lost 5s. to 10s. each in price. The unanimous nature of the fall suggests precautionary marking-down by the dealers rather than any particular pressure to realise on the part of holders. The solitary rise in Electric Lighting shares is secured by Urban Preference, which at 5¼ are 1/16 better on the week. Holders of the metropolitan companies' shares are fidgetting with uneasiness over the new Electric Power Bill, and business being as restricted as it is, this nervousness finds ready reflection in quotations.

**Eastern Telegraph Co.**—The directors have declared an interim dividend of 1½ per cent. on the ordinary stock for the quarter ending December 31st, 1904.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1902. | 1903. | 1904. | Closing Quotations March 22nd. | Closing Quotations March 29th. | Business done week ended March 29th, 1905. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 67,100 | African Direct Telegraph, 4 % Debs. | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | .. | .. | .. | 2¼ — 2⅜ | 2¼ — 2⅜ | .. | .. |
| 119,700‡ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | .. | .. | .. | 70 — 75 | 71 — 76 | 75 | 73 |
| 788,840 | Anglo-American Telegraph | Stock | 60/6 | 61s. | 2½% | 62 — 64 | 61 — 63 | 63½ | 62 |
| 3,105,580 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 6% | 108 —109 | 108 —109 | 109 | 108 |
| 3,105,580 | Do. do. do. Deferred | Stock | 1/- | 2s. | Nil | 16⅜ — 17⅛ | 15⅞ — 16⅛ | 17⅛ | 15⅛ |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 6 % | 7 % | .. | 6⅜ — 6⅝ | 6⅜ — 6⅝ | .. | .. |
| 18,888,300$ | Commercial Cable | $100 | 8 % | .. | .. | 230 —240 | 230 —240 | .. | .. |
| 1,841,209 | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | .. | .. | .. | 98 —100 | 98 —100 | 99½ | .. |
| 16,000 | Cuba Telegraph | 10 | 6½% | 5 % | .. | 8⅜ — 9½ | 8⅜ — 9½ | .. | .. |
| 6,000 | Do. 10 % Pref. | 10 | .. | .. | .. | 17 — 18 | 17 — 18 | .. | .. |
| 12,931 | Direct Spanish Telegraph, Ord. | 5 | .. | .. | .. | 3⅜ — 3⅝ | 3⅜ — 3⅝ | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | .. | .. | .. | 8¾ — 9 | 8¾ — 9 | .. | .. |
| 80,000 | Do. do. 4½ % Debs. | 50 | .. | .. | .. | 101 —103⅝ | 101 —103 | .. | .. |
| 60,710‡ | Direct United States Cable | 20 | 3½% | 3 % | .. | 11⅜ — 11⅝ | 11⅜ — 11⅝ | 11⅜ | 11⅜ |
| 78,500 | Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 100 —102 | 100 —102 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | .. | 145 —148 | 144 —147 | 146¾ | 144½ |
| 1,955,565 | Do. 8½ % Pref. Stock | 100 | .. | .. | .. | 92 — 94 | 92 — 94 | 92⅝ | .. |
| 1,534,645 | Do. 4 % Mort. Deb. Stock Red. | Stock | .. | .. | .. | 107 —109 | 107 —109 | 108¾ | 108 |
| 800,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | .. | 14½ — 15 | 14⅛ — 14⅜ | 14⅛ | 14⅛ |
| 800,000‡ | Do. 4 % Deb. Stock | Stock | .. | .. | .. | 105 —107 | 105 —107 | 106¾ | 105¾ |
| 800,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909 | 100 | .. | .. | .. | 100 —102 | 100 —102 | .. | .. |
| 800,000‡ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | .. | .. | .. | 101 —103 | 101 —103 | .. | .. |
| 180,237 | Globe Telegraph and Trust | 10 | £3 16 7* | 5½% | .. | 10⅜ — 11 | 10⅜ — 11 | 10⅜ | 10⅜ |
| 180,042 | Do. do. 6 % Pref. | 10 | .. | .. | .. | 14⅜ — 14⅝ | 14⅜ — 14⅝ | 14⅜ | 14⅛ |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 12½% | 15 % | 24 % | 35½ — 36½ | 32 — 40 | 32⅜ | 36⅜ |
| 60,600 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 100 —102 | 100 —102 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10% | 10 % | .. | 47 — 49 | 47 — 49 | .. | .. |
| 72,680 | Monte Video Telephone Co., Ltd., Ord. | 1 | 3 % | 3 % | .. | ⅛ — ⅛ | ⅛ — ⅛ | .. | .. |
| 1,988,888 | National Telephone, Pref. Stock | 100 | 6 % | 6 % | 6 % | 110 —111 | 109½ —110½xd | 110½ | 109½ |
| 1,966,667 | Do. do. Def. Stock | 100 | 4½% | 5 % | 5 % | 103 —105½ | 103 —105 xd | 104½ | 103½ |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 12½ — 13½ | 12½ — 13½xd | .. | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 12 — 13 | 12 — 13 xd | .. | .. |
| 2,250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 2½% | 5⅜ — 5⅝ | 5⅜ — 5⅝xd | 5⅜ | 5⅛ |
| 000,000‡ | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 4 % | 100 — 102 | 100 — 102 | 100⅝ | 100½ |
| 689,593 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | .. | 104 —106 | 104 —105½ | 104⅝ | 103½ |
| 179,318 | Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid | 1 | 6 % | 6½% | .. | 1½ — 1⅝ | 1½ — 1⅝ | .. | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. | 1 | .. | .. | .. | 1⅞ — 1⅞ | 1⅞ — 1⅞ | .. | .. |
| 100,000 | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | .. | .. | .. | 99 - 102 | 99 —102 | .. | .. |
| 11,689‡ | Reuter's | 8 | 5 % | .. | .. | 7½ — 7⅝ | 7½ — 7⅝ | .. | .. |
| 8,808 | Submarine Cables Trust | Certs. | .. | .. | .. | 125 —128 | 125 —128 | .. | .. |
| 58,000 | United River Plate Telephone | 5 | 7 % | .. | .. | 7½ — 7⅝ | 7 — 7½ | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | .. | .. | .. | 5 — 5⅛ | 5 — 5⅛ | 5⅛ | .. |
| 179,947 | Do. do. 5 % Debs. | Stock | .. | .. | .. | 107 —109 | 107 —109 | .. | .. |
| 15,609‡ | West African Telegraph, Shares | 10 | 2 % | 4 % | .. | 8 — 8½ | 8 — 8½ | .. | .. |
| 80,008 | West Coast of America, 1 to 80,000 and 53,001 to 53,008 | 2½ | .. | .. | .. | ⅞ — 1 | ⅞ — 1 | .. | .. |
| 150,000 | West Coast of America, 4% Debs., 1 to 1,500 guar. by Brss. Sub. Tel. | 100 | .. | .. | .. | 100 —102 | 100 —102 | .. | .. |
| 207,980‡ | Western Telegraph, Ltd., Nos. 1 to 207,980 | 10 | 7 % | 7 % | .. | 14 — 14½ | 13⅞ — 14⅛ | 14⅛ | 13⅝ |
| 75,000 | Do. do. 5 % Debs. 2nd series, 1905 | 100 | .. | .. | .. | 101 —103 | 101 —103 | .. | .. |
| 400,000‡ | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 103 —105 | 103 —105 | 103 | .. |
| 88,321 | West India and Panama Telegraph | 10 | .. | .. | .. | ⅛ — 1 | ⅛ — ⅛ | .. | .. |
| 34,553 | Do. do. do. 6 % Cum. 1st Pref. | 10 | .. | .. | .. | 8½ — 9 | 8½ — 9 | 8⅝ | .. |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | .. | .. | .. | 8¼ — 8⅝ | 8 — 8½ | .. | .. |
| 89,000‡ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | .. | .. | .. | 103 —105 | 103 —105 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | British Aluminium 7 % Cum. Pref. | 5 | .. | .. | .. | 4½ — 5 | 4½ — 5 | .. | .. |
| 10,000 | Do. do. "A" 6 % Cum. Pref. | 5 | .. | .. | .. | 4⅝ — 5⅛ | 4⅝ — 5⅛ | .. | .. |
| 800,000‡ | Do. do. 5 % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 98 — 102 | 98 - 102 | .. | .. |
| 100,000 | British Electric Traction | 10 | 8 % | .. | .. | 9¼ — 9⅝ | 9⅛ — 9⅜ | 9⅛ | 9⅛ |
| 100,000 | Do. do 6 % Cum. Pref. | 10 | .. | .. | .. | 10⅝ — 11⅛ | 10⅝ — 11⅛ | 11 | 10⅝ |
| 600,000‡ | Do. do. 5 % Perpetual Debenture Stock | Stock | .. | .. | .. | 122 —124 | 123 —125 | 124 | 123 |
| | Do. do. 4½% 2nd Deb. Stock Red. | 100 | .. | .. | .. | 98 — 100 | 95 — 97 | 98 | 98¼ |
| 100,000 | British Insulated and Helsby Cables | 5 | 10 % | 8 % | 8 % | 5⅞ — 6⅛ | 5⅞ — 6⅛ | 6⅛ | 5⅞ |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | .. | .. | .. | 6⅛ — 6⅜ | 5⅞ — 6 | 5⅞ | .. |
| 50,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | .. | .. | .. | 101 —104 | 101 —104 | 10⅛ | 102⅛ |
| 50,000 | Browett, Lindley & Co., Ord. | £1 | .. | .. | .. | ⅜ — ⅝ | ⅜ — ⅝ | .. | .. |
| 50,000 | Do. do. 6 % Cum. Pref. | £1 | .. | .. | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. |
| 105,781 | Brush Electrical Engineering, Ord., 1 to 105,781 | 2 | Nil | Nil | .. | ¾ — ¾ | ¾ — ¾ | .. | .. |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 6 % | 6 % | .. | 1⅝ — 2 | 1⅝ — 2 | .. | .. |
| 125,000‡ | Do. do. 4½ % Perp. Deb. Stock | Stock | .. | .. | .. | 94 — 95 | 92 — 95 | .. | .. |
| 125,000‡ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | .. | .. | .. | 79 — 82 | 79 — 82 | 80⅜ | .. |
| 85,000 | Callender's Cable Construction shares | 5 | 15 % | 12½% | .. | 11 — 11⅛ | 11 — 11⅛ | 11⅛ | .. |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 5⅜ — 5⅝ | 5⅜ — 5⅝ | 5⅝ | .. |
| 90,000‡ | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 106 —108 | 106 —108 | .. | .. |
| 1,480,014 | Central London Railway, Ord. Stock | Stock | 4 % | 4 % | .. | 93 — 95 | 93 — 95 | 93 | .. |
| 494,098 | Do. do. 4 % Pref. Stock | Stock | 4 % | 4 % | .. | 101 —103 | 1 1—103 | 102⅜ | 102 |
| 494,998 | Do. do. Def. do. | Stock | 4 % | 4 % | .. | 83 — 85 | 83 — 86 | .. | .. |
| 1,980,000 | City and South London Railway | Stock | 3½% | 2¾% | 2½% | 44⅜ — 45⅛ | 44⅛ — 45⅛ | 45 | 44½ |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 2 | 5 % | .. | .. | 2⅛ — 2⅜ | 2⅛ — 2⅜ | .. | .. |
| 100,000‡ | Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red. | .. | .. | .. | .. | 98 — 98 | 98 — 98 | .. | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261 | ⅛ | Nil | .. | .. | 1 — 1¼ | 1 — 1¼ | .. | .. |
| 17,189 | Do. do. "A" shares, 01—017,189 | ⅛ | Nil | .. | .. | 1⅜ — 2¼ | 1⅜ — 2¼ | .. | .. |
| 844,923‡ | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 80 — 85 | 80 — 85 | .. | .. |
| 100,000‡ | Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd. | 100 | .. | .. | .. | 86 — 91 | 86 — 91 | .. | .. |
| 112,100 | lectric Construction 1 to 112,100 | 2 | 6 % | 4 % | .. | 1¼ — 1½ | 1 — 1½ | .. | .. |
| 81,890 | Do. do. 7 % Cum. Pref., 1 to 81,890 | 2 | .. | .. | .. | 2¼ — 2½ | 2¼ — 2⅜ | .. | .. |
| 82,500‡ | Do. do. 4 % Perp. 1st Mort. Deb. Stock | Stock | .. | .. | .. | 97 — 99 | 97 — 99 | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | .. | .. | 9½ — 10 | 9½ — 10 | .. | .. |
| 200,000 | Do. do. 4 % Mort. Deb. | Stock | .. | .. | .. | 91 — 96 | 91 — 96 | .. | .. |
| 200,000 | Henley's (W. T.) Telegraph Works, Ord. | 5 | 20 % | 15 % | 15 % | 12½ — 13 xd | 12½ - 13 xd | 12⅛ | .. |
| 200,000 | Do. do. 4½ % Pref. | 5 | .. | .. | .. | 5⅜ — 5⅝ | 5⅜ — 5⅝ | 5⅝ | 5⅞ |
| 45,900 | Do. do. 4½ Mort. Deb. Stock | Stock | .. | .. | .. | 109 —111 | 109 —111 | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | .. | .. | 16 — 17 | 16 — 17 | 17 | .. |
| 800,000‡ | Do. do. do. 4 % 1st Mort. Deb. | 100 | .. | .. | .. | 100—103 | 100 —103 xd | 100 | .. |
| 37,500 | Liverpool Overhead Railway, Ord. | 10 | 1½% | 1½% | 1½% | 3½ — 3⅝ | 3½ — 3⅝ | .. | .. |
| 10,000 | Do. do. Pref. £10 paid | 10 | .. | .. | .. | 9½ — 9⅝ | 9½ — 9⅝ | .. | .. |
| 37,850 | Telegraph Construction and Maintenance | 12 | 27½ | 20 % | 15 % | 35 — 38 xd | 36 — 38 xd | 36½ | .. |
| 150,000‡ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1908 | 100 | .. | .. | .. | 103 —105 | 103 —105 | .. | .. |
| 540,000‡ | Waterlow & City Railway, Ord. Stock | 100 | 3½% | 3½% | 3½% | 92 — 94 | 92 — 94 | 92½ | .. |

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

Bank rate of discount 2½ per cent. (March 9th, 1905).

## SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

| Present Issue. | NAME. | Stock or Share. | Dividends for the last three years 1902. | 1903 | 1904. | Closing Quotations March 22nd. | Closing Quotations Mar. 29th. | Business done week ended Mar. 29th, 1905. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| | | ‡ | | | | | | | |
| 20,000 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 .. | £5 | 8 % | 10 % | 10 % | 10¼ — 10⅝ | 10 — 11 | 10¼ | .. |
| 20,000 | Do. do. 7 % Cum. Pref. .. | £5 | .. | .. | .. | 10 — 10⅛ | 10 — 10¼ | .. | .. |
| 250,000 | Central Electric Supply 4 % Guar. Deb. Stock .. .. .. .. | £100 | .. | .. | .. | 105 —108 | 105 —108 | .. | .. |
| 50,000 | Charing Cross and Strand Electricity Supply .. .. .. .. | £5 | 10 % | 8 % | 8 % | 8 — 8⅛ | 8 — 8⅛ | 8⅝ | 8⅜ |
| 70,000 | Do. do. do. 4½% Cum. Pref. .. | £5 | .. | .. | .. | f⅛ — 5⅜ | 5⅛ — 5⅜ | 5⅜ | .. |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. .. | £5 | .. | .. | .. | 5 — f⅛ | 5 — f⅛ | 5⅛ | .. |
| 40,000 | Do. do. 1903 .. .. .. .. .. | £5 | .. | .. | .. | 5 — 5⅛ | 5 — f⅛ | 5 7/16 | .. |
| 950,000 | Do. do. 4 % Deb. Stock Red. .. .. .. .. | £100 | .. | .. | .. | 105 —107 | 105 —107 | .. | .. |
| 44,486 | *Chelsea Electricity Supply, Ord. .. .. .. .. .. | £5 | 4½% | 5½% | 6 % | 6⅜ — 7⅛ | 6⅜ — 7⅛ | 6⅞ | .. |
| 150,000‡ | Do. do. % Deb. Stock Red. .. .. .. .. | Stock | .. | .. | .. | 109 —111 | 109 —111 | .. | .. |
| 70,595 | City of London Electric Lighting, Ord. 40,001—110.595 .. | £10 | 5 % | 5 % | 6 % | 11⅛ — 12½ | 11 — 12 xd | 11⅜ | .. |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 .. .. .. .. | £10 | .. | .. | .. | 13⅞ — 14 | 13¾ — 14 xd | 13 13/16 | 11⅜ |
| 400,000‡ | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid .. | .. | .. | .. | .. | 128 —127 | 128 —127 | .. | .. |
| 900,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid .. | £100 | .. | .. | .. | 103 —105 | 103 —105 | .. | .. |
| 40,000 | County of London Electric Lighting, Ord. 1—40,000 .. .. | £10 | 4 % | 4 % | 4½% | 9¾ — 10 | 9¾ — 10 | 9⅞ | .. |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60 .. | £10 | .. | .. | .. | 12¾ — 12¾ | 12¾ — 12¾ | .. | .. |
| 400,000‡ | Do. do. 4½% Deb. Stock .. .. .. .. | .. | .. | .. | .. | 110 —113 | 110 —113 | .. | .. |
| 250,000 | Do. do. 4½% 2nd Deb. Stock .. .. .. .. | Stock | .. | .. | .. | 104 —106 | 104 —106 | 105½ | 105 |
| 70,000 | Edmundson's Electric Corporation, Ord. Shares .. .. .. | £5 | 7 % | 7 % | .. | 6⅞ — 6⅞ | 6⅞ — 6⅞ | 6 15/16 | 6 13/32 |
| 70,000 | Do. do. 6 % Cum. Pref. .. .. .. | .. | .. | .. | .. | 6⅝ — 6⅞ | 6⅝ — 6⅞ | 6⅞ | 6⅞ |
| 800,000 ‡ | Do. do. 4½% 1st Mort. Deb. Stock .. | £100 | .. | .. | .. | 106 —108 | 106 —108 | .. | .. |
| 21,000 | Kensington and Knightsbridge Electric Ord. .. .. .. .. | £5 | 10 % | 12½ | 12 % | 12⅜ — 13½ | 12 — 13 | 13½ | .. |
| 90,000 | Do. do. do. 4 % Debenture Stock .. | Stock | .. | .. | .. | 102 —104 | 102 —104 | 103⅝ | 103½ |
| 110,000 | London Electric Supply Corporation, Limited, Ord. .. .. .. | £8 | .. | .. | 3 % | 2 3/16 — 2 3/16 | 2⅛ — 3 | .. | .. |
| 49,840 | Do. do. do. 6 % Pref. .. .. .. | £5 | .. | .. | .. | 6⅛ — 6 | 5⅝ — 6 | .. | .. |
| 250,000‡ | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | .. | .. | .. | 99 —101 | 99 —101 | 99½ | .. |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 .. .. .. .. .. | £10 | 7½% | 8½% | 10 % | 18⅛ — 18⅜xd | 17⅞ — 18⅛xd | 18⅜ | 18 |
| 71,106 | Do. do. 4½% Cum. Pref. 1—71,106, £3 paid .. | £5 | .. | .. | .. | 5⅜ — 5⅝ | f⅜ — f⅜ | 5⅝ | .. |
| 220,000‡ | Do. do. 4½% 1st Mort. Deb. Stock .. .. | .. | .. | .. | .. | 110 —115 | 110 —115 | .. | .. |
| 250,000‡ | Do. do. 3½% Mort. Deb. Stock Red .. .. | Stock | .. | .. | .. | 97 — 99 | 97 — 99 | .. | .. |
| 250,000 | Midland Electric Corporation, 4½ % 1st Mort. Deb. .. .. .. | £100 | .. | .. | .. | 99 —101 | 99 —101 | 99⅞ | 99⅜ |
| 10,852 | Notting Hill Electric Lighting .. .. .. .. .. .. | £10 | 6 % | 6 % | 7 % | 14⅛ — 15⅛xd | 14⅜ — 15⅛ | .. | .. |
| 59,000 | Do. do. 4% 1st Mort. Deb. .. .. .. .. | £100 | .. | .. | .. | 102 —104 | 102 —104 | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. .. .. .. .. | £5 | 14½% | 14½% | 14½% | 14 — 14⅜ | 13⅞ — 14⅜ | 14⅛ | 13⅞ |
| 20,000 | Do. do. do. 7 % Pref. 20,081 to 40,000 | £5 | .. | .. | .. | 8⅛ — 8⅜ | 8⅛ — 8⅜ | .. | .. |
| 150,000‡ | Do. do. do. 3½% Mort. Deb. Stock Red .. | £100 | .. | .. | .. | 98 —100 | 98 —100 | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. .. .. .. .. | £5 | 2½% | 4 % | .. | 2⅜ — 3⅛ | 2⅜ — 3⅛ | .. | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock .. .. | Stock | .. | .. | .. | 79 — 83 | 79 — 83 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. .. .. .. .. .. | £5 | .. | 12½% | 8 % | 4 — 4¼xd | 3⅞ — 4¼xd | 4 7/32 | 4 |
| 100,000 | South Metropolitan Electric Light and Power (Ord. .. .. | £1 | .. | .. | .. | ⅞ — 1 | ⅞ — 1 | .. | .. |
| 50,000 | (*Late Blackheath and Greenwich* 7 % Pref. .. .. | £1 | .. | .. | .. | 1⅜ — 1 7/16xd | 1⅜ — 1 7/16xd | 1⅜ | .. |
| 100,000 | *Dist. E.L.Co.*) 4½% 1st Deb. Stock | £100 | .. | .. | .. | 107 —110 | 107 —110 | .. | .. |
| 80,000 | Urban Electric Supply, Ord. .. .. .. .. .. .. | £5 | .. | .. | .. | 5 5/16 — 5 7/16 | 5 5/16 — 5 7/16 | 5 5/16 | .. |
| 80,000 | Do. do. 5 % Cum. Pref. .. .. .. .. .. | £5 | .. | .. | .. | 5⅛ — 5⅜ | 5⅛ — 5⅜ | 5 5/16 | .. |
| 200,000 | Do. do. 4½% 1st Mort. Deb. Stock Red .. .. | £100 | .. | .. | .. | 106 —108 | 106 —108 | .. | .. |
| 110,000 | Westminster Electric Supply, Ord. .. .. .. .. .. | £5 | 12 % | 13½% | 14% | 12⅜ — 13½ | 12 — 13 | 12⅞ | 12⅜ |
| 28,141 | Do. do. 5 % Cum. Pref. .. .. .. .. | £5 | .. | .. | .. | 6⅛ — 6⅜ | 6⅛ — 6⅜ | 6 13/32 | 6 7/16 |

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| Locality. | Fortnight ended. | Receipts for the fortnight. £ | £* | No. of wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|
| Aberdeen .. .. | Mar. 25 | 2,170 | — 40 | 43 | 57,391 | + 5,685 | .. | .. |
| Ayr .. .. .. | ,, 25 | 384 | + 48 | 45 | 12,491 | + 664 | .. | .. |
| Bath .. .. .. | ,, 8 | 1,034 | + 49 | 10 | 5,298 | + 517 | 12½ | .. |
| Birkenhead .. .. | ,, 26 | 1,957 | .. | 51 | 53,041 | — 94 | 13·5 | .. |
| Blackburn .. .. | .. | .. | .. | .. | .. | .. | 13½ | .. |
| Blackpool .. .. | ,, 23 | 787 | + 189 | 51 | 47,317 | + 6,372 | 18½ | .. |
| ,, —Fleetw'd | ,, 25 | 434 | + 43 | 12 | 2,275 | — 59 | .. | .. |
| ,, — Lytham | ,, 18 | 354 | + 25 | 21 | 2,791 | .. | .. | .. |
| Bolton .. .. | ,, 26 | 3,589 | + 358 | 52 | 93,772 | + 756 | 26 | .. |
| Bournemouth .. | ,, 22 | 2,015 | + 234 | 51 | 53,963 | .. | 10·15 | .. |
| †Bradford .. .. | Feb. 23 | 7,494 | + 557 | .. | 207,0 9 | + 20,778 | 54 | .. |
| Brighton .. .. | Mar. 26 | 1,694 | + 242 | 51 | 49,523 | .. | 9½ | .. |
| Bristol .. .. | ,, 24 | 9,210 | + 140 | .. | .. | .. | .. | .. |
| Brit. Elec. Trac. Co. | | | | | | | | |
| Airdrie .. .. | Mar. 17 | 393 | + 26 | 11 | 2,125 | — 5 | .. | .. |
| Barnsley .. .. | ,, 17 | 820 | + 17 | ,, | 1,642 | + 54 | .. | .. |
| Barrow .. .. | ,, 17 | 398 | + 142 | ,, | 1,982 | + 295 | .. | .. |
| Birmingham (City) | ,, 17 | ‡11,209 | +1,080 | ,, | ‡57,666 | + 2,878 | .. | .. |
| Birmingham (Mid.) | ,, 17 | ‡3,485 | + 5 6 | ,, | ‡18,126 | + 2,267 | .. | .. |
| Devonport .. .. | ,, 17 | 825 | — 69 | ,, | 4,606 | — 209 | .. | .. |
| Dudley—Sto'rb'ge | ,, 17 | 1,588 | + 121 | ,, | 8,013 | + 237 | .. | .. |
| Gateshead .. .. | ,, 17 | 1,770 | + 97 | ,, | 9,386 | + 305 | .. | .. |
| Gravesend, N'fleet | ,, 17 | 394 | — 37 | ,, | 2,012 | — 204 | .. | .. |
| Gr'n'k, Pt. Glsgw | ,, 17 | 1,065 | + 186 | ,, | 5,610 | + 698 | .. | .. |
| Hartlepool .. | ,, 17 | 500 | + 21 | ,, | 2,602 | — 17 | .. | .. |
| Kidderminster .. | ,, 17 | 184 | — 12 | ,, | 972 | — 26 | .. | .. |
| Merthyr .. .. | ,, 17 | 372 | — 5 | ,, | 1,889 | — 120 | .. | .. |
| Metropolitan .. | ,, 17 | ‡3,715 | +1,407 | ,, | ‡20,397 | + 8,723 | .. | .. |
| Middleton .. .. | ,, 17 | 529 | + 38 | ,, | 2,787 | + 186 | .. | .. |
| Oldham — Ashton | ,, 17 | 1,000 | + 38 | ,, | 5,238 | + 89 | .. | .. |
| Peterborough .. | ,, 17 | 111 | — 10 | ,, | 1,087 | — 67 | .. | .. |
| Poole .. .. | ,, 17 | 459 | — 48 | ,, | 2,340 | — 80 | .. | .. |
| Potteries .. .. | ,, 17 | 3,360 | + 72 | ,, | 17,565 | + 450 | .. | .. |
| Rothesay .. .. | ,, 17 | 89 | + 3 | ,, | 480 | + 37 | .. | .. |
| Sheerness .. .. | ,, 15 | 121 | + 31 | ,, | 578 | + 105 | .. | .. |
| Southport .. .. | ,, 17 | 464 | + 13 | ,, | 2,447 | — 40 | .. | .. |
| South Staffs. .. | ,, 17 | 1,341 | — 81 | ,, | 6,952 | — 483 | .. | .. |
| Swansea .. .. | ,, 17 | 1,033 | + 157 | ,, | 4,989 | + 176 | .. | .. |
| Taunton .. .. | ,, 17 | 89 | — 1 | ,, | 431 | — 57 | .. | .. |
| Tynemouth .. .. | ,, 17 | 325 | — 48 | ,, | 1 831 | — 510 | .. | .. |
| Weston-s-Mare .. | ,, 15 | 57 | + 6 | ,, | 285 | + 41 | .. | .. |
| Wolverhampton D. | ,, 17 | 704 | + 35 | ,, | 3,622 | + 180 | .. | .. |
| Worcester .. .. | ,, 17 | 532 | + 71 | ,, | 2,711 | + 734 | .. | .. |
| Wrexham .. .. | ,, 17 | 195 | + 9 | ,, | 1,055 | — 25 | .. | .. |
| Yorks. Wool. Dist. | ,, 17 | 1,141 | + 132 | ,, | 5,948 | + 665 | .. | .. |
| Burnley .. .. | Mar. 25 | 2,075 | + 301 | .. | .. | .. | .. | .. |
| Burton-on-Trent .. | ,, 26 | 615 | + 45 | 51½ | 17,213 | .. | 8½ | .. |
| Bury .. .. .. | .. | .. | .. | .. | .. | .. | .. | .. |

| Locality. | Fortnight ended. | Receipts for the fortnight. £ | £* | No. of wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|
| Cardiff .. .. | Mar. 18 | 3,769 | + 168 | 50 | 100,508 | + 2,170 | .. | .. |
| Carlisle .. .. | ,, 25 | 284 | — 46 | 12 | 1,714 | — 2·4 | .. | .. |
| Chatham and Dist. | ,, 23 | 1,755 | + 270 | 12 | 6,826 | + 200 | 9·3 | + ·8 |
| Colchester .. .. | ,, 22 | 333 | .. | 34 | 7,494 | .. | 13 75 | .. |
| Cork .. .. .. | ,, 23 | 860 | + 69 | 11 | 4,816 | + 205 | 9·9 | .. |
| †Darlington .. .. | ,, 18 | 1,184 | .. | 44 | 8,000 | .. | 4·87 | .. |
| Darwen .. .. .. | ,, 24 | 434 | + 27 | 51 | 1 ,521 | — 40 | 4·36 | .. |
| Dundee .. .. .. | ,, 22 | 1,568 | + 39 | .. | .. | .. | .. | .. |
| †Dover .. .. .. | ,, 18 | 170 | + 4 | 11 | 1,822 | — 89 | .. | .. |
| Dublin .. .. .. | ,, 24 | 9,272 | + 552 | .. | 52,465 | + 980 | 48 | + 1 |
| East Ham .. .. | ,, 25 | 1,562 | + 268 | 51 | 36,659 | + 2,199 | .. | .. |
| Glasgow .. .. | ,, 25 | 19,337 | + 2,442 | 42½ | 610,916 | +31,677 | 72½ | + 4 |
| Gloucester .. .. | ,, 24 | 493 | .. | 46 | 13,204 | .. | 15 | .. |
| Halifax .. .. | ,, 22 | 2,613 | + 156 | 51 | 72,389 | + 5,540 | 35½ | + 2½ |
| Huddersfield .. | ,, 25 | 2,443 | + 280 | 51 | 68,295 | + 4,522 | .. | .. |
| Hull .. .. .. | ,, 25 | 4,302 | + 292 | 51 | 111,190 | +11,672 | 18 | .. |
| †Ilford .. .. | Feb. 25 | 316 | + 9 | 47½ | 20,845 | + 1,050 | .. | .. |
| Ilkeston .. .. | Mar. 22 | 234 | — 31 | 51 | 6,653 | .. | 3·5 | .. |
| Ipswich .. .. | ,, 25 | 702 | + 50 | 51 | 23,038 | .. | 10½ | .. |
| Isle of Thanet .. | ,, 25 | 607 | + 62 | 12 | 2,937 | + 216 | .. | .. |
| Kirkcaldy .. .. | ,, 22 | 406 | + 22 | .. | .. | .. | .. | .. |
| Lan'kshire Trm. Co. | ,, 23 | 1,267 | + 124 | 12 | 7,542 | + 689 | 8·60 | .. |
| Leeds .. .. .. | ,, 25 | 11,020 | + 934 | 52 | 295,273 | +18,052 | 89½ | + 8½ |
| Leicester .. .. | ,, 25 | 3,866 | .. | 12 | 21,488 | .. | .. | .. |
| Liverpool .. .. | ,, 18 | 19,912 | +1,076 | 11 | 107,100 | + 4,483 | 108 | .. |
| L.C.C. .. .. | ,, 11 | 21,783 | +5,514 | 49½ | 625,282 | +139,742 | 47½ | + 7⅝ |
| Lowestoft .. .. | ,, 25 | 246 | — 1 | .. | .. | .. | .. | .. |
| Manchester .. .. | ,, 25 | 24,392 | +2,725 | 51 | 618,295 | +30,540 | .. | .. |
| Newcastle .. .. | ,, 25 | 7,126 | + 221 | .. | .. | .. | .. | .. |
| Newport .. .. | ,, 25 | 1,054 | + 202 | 25 | 12,631 | + 1,756 | 14½ | + 1½ |
| Oldham .. .. | ,, 24 | 2,498 | + 931 | 52 | 65,554 | + 6,299 | 22½ | + 4⅝ |
| Plymouth .. .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Portsmouth .. .. | ,, 25 | 3,181 | + 377 | 52 | 94,400 | + 6,874 | 14½ | .. |
| Reading .. .. | ,, 23 | 1,165 | + 107 | 51 | 31,982 | .. | 13·12 | .. |
| Rochdale .. .. | ,, 25 | 931 | + 728 | 52 | 14,547 | .. | 14·86 | 10·2 |
| Salford .. .. | ,, 20 | 7,971 | + 662 | 50 | 203,373 | +102,571 | 30 | .. |
| †Scarborough .. | ,, 18 | 70 | .. | 11 | 734 | .. | 3½ | .. |
| Sheffield .. .. | ,, 26 | 9,310 | + 618 | 52 | 240.556 | + 8,214 | 94½ | + 1½ |
| †Southampton .. | ,, 15 | 828 | + 12 | 50 | 47,388 | — 2,665 | .. | .. |
| Southend-on-Sea .. | ,, 22 | 491 | + 60 | 51 | 17,671 | + 1,665 | 6½ | .. |
| Stockport .. .. | ,, 24 | 967 | + 155 | 51 | 27,307 | + 8,735 | 11½ | + 1 |
| †Sunderland .. | ,, 20 | 1,144 | + 80 | 50 | 62,4 5 | + 1,476 | 21 | + 1 |
| Tyneside .. .. | ,, 22 | 786 | + 132 | 12 | 3,898 | + 190 | .. | .. |
| †Warrington .. | ,, 16 | 301 | + 26 | 50 | 15,925 | .. | 7½ | .. |
| West Ham .. .. | ,, 18 | 2,344 | .. | .. | 55,703 | .. | 9 78 | .. |
| Wolverhampton .. | ,, 22 | 1,420 | + 410 | 51 | 35,799 | .. | .. | .. |
| Cen. London Rly. | Mar. 25 | 14,095 | — 247 | 12 | 56,153 | + 918 | 6 | .. |
| City & S. Lon. Rly. | ,, 26 | 5,717 | — 412 | 13 | 38,901 | — 2,503 | 6½ | .. |
| Dublin-Lucan Rly. | ,, 24 | 211 | + 17 | 12 | 1,132 | + 32 | 7 | .. |
| G. N. and City Rly. | ,, 25 | 3,203 | +1,202 | 12 | 19,256 | .. | 3½ | .. |
| L'pool Overh'd Rly. | ,, 26 | 3,025 | — 87 | 12 | 19,096 | — 694 | 6·57 | .. |
| Mersey Railway .. | ,, 25 | 3,136 | + 207 | 12 | 19,079 | + 1,295 | 4½ | .. |

* Compared with the corresponding period of 1904. † One week only. ‡ Includes horse and other receipts.

## EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING FEBRUARY, 1905.

The tabulated figures given below are based upon the official returns of electrical exports and imports for the month of February. From their detailed nature we anticipate that they will prove of value to those engaged in the electrical industry in Great Britain, and that they will also furnish an approximate index not only of the state of the electrical trades, but also in many cases of the nature and origin of our competitors' trade, and of the character of the possible trade to any country, for export purposes. The British exporter can, in fact, see, in concise form, the possible trade centres of interest to him individually in any part of the world.

The import figures convey some idea of the extent to which we depend upon Scandinavia for telephone requisites. From this locality we imported during the month of February some £13,500 worth of such material.

The United States, with £16,000 worth of electrical machinery imported into this country, is especially noticeable. On the other hand, Japan, India and New Zealand were our prominent customers during the month in question.

In reading the imports table, it should be noted that the countries exporting are not necessarily the countries of origin, which explains to a great extent the absence of such countries as Switzerland, Italy and Austria; in the same way the final destination, in the case of certain European countries mentioned in the export section, is not necessarily the country of entry.

As explained in the foot-note to the table, the first and third columns unavoidably contain considerable amounts for goods, otherwise unspecified; it is also obvious that much electrical material is both exported and imported under such classifications as hardware, earthenware, glass, lead, zinc, iron wire, &c., and for that reason does not appear in the table below.

### Registered Exports of British and Irish Electrical Goods from the United Kingdom.

| Country receiving exports and importing. | Electrical goods and appliances. | Electric light and power cable. | Electric lighting fittings and accessories. | Electric lamps. | Electric meters and instruments. | Electric machinery. | Batteries and accumulators. | Carbons. | Telegraph and telephone material and electric bells. | Electrically-driven machinery. | Tramways apparatus and materials. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | £ | £ | £ | £ | £ | £ | £ | £ | £ | £ | £ |
| Russia, Sweden, Norway and Denmark ... | 161 | 189 | 52 | 50 | 32 | 169 | ... | 3 | 5,136 | 47 | ... |
| Germany | 139 | 94 | 17 | ... | 25 | 40 | ... | 60 | 120 | 35 | ... |
| Netherlands | 42 | 251 | 315 | ... | ... | ... | 10 | ... | ... | 277 | ... |
| Java, Dutch Borneo and Dutch Indies | ... | ... | 168 | 56 | ... | ... | 5 | ... | ... | ... | ... |
| Belgium | 150 | 21 | 46 | 30 | ... | ... | 2 | ... | ... | ... | ... |
| France | 420 | .. | 178 | 3 | 147 | 242 | 181 | ... | ... | 52 | ... |
| Portugal, Madeira, and Portuguese Africa | 25 | 85 | 19 | ... | ... | 935 | ... | ... | 46 | ... | ... |
| Spain and Canary Isles | 45 | 26 | 8 | 8 | 155 | 58 | 6 | ... | 3 | 1,950 | ... |
| Italy | 12 | ... | ... | ... | 715 | ... | ... | ... | 28 | 31 | ... |
| Greece | 10 | ... | ... | ... | 16 | ... | ... | ... | ... | 4 | ... |
| Cape of Good Hope | 923 | 1,857 | 564 | 94 | 438 | 1,002 | 1,352 | 96 | 167 | 1,039 | ... |
| Bulgaria and Turkey | ... | ... | 155 | 4 | ... | ... | ... | ... | .. | ... | ... |
| China and Siam | 612 | ... | 114 | 65 | 229 | 873 | ... | ... | 12 | 7 | 170 |
| Egypt | 460 | 222 | 36 | 5 | ... | 381 | 49 | 2 | 37 | ... | ... |
| Japan | 2,239 | 2,784 | 383 | ... | 216 | 6,673 | ... | ... | 968 | ... | ... |
| U.S.A., Philippines and Cuba | 108 | ... | ... | 35 | 83 | 549 | ... | ... | ... | ... | ... |
| Mexico, San Salvador, Peru and Uruguay | ... | .. | 269 | ... | ... | 805 | ... | ... | ... | ... | ... |
| Chili | 17 | 156 | 181 | 25 | 87 | 283 | ... | ... | 20 | ... | 20 |
| Brazil | 149 | 7 | 111 | 83 | ... | 898 | 72 | 3 | 12 | 423 | ... |
| Argentine | 1,860 | 1,569 | 95 | 124 | 200 | 1,644 | 72 | ... | 80 | 70 | ... |
| Channel Isles, Gibraltar and Malta | 140 | 34 | 199 | 6 | 35 | 382 | ... | ... | 3 | ... | ... |
| British West Africa and St. Helena | 33 | 19 | 14 | ... | 133 | 221 | 3 | ... | 18 | ... | ... |
| Natal | 1,468 | 509 | 1,166 | 156 | 121 | 1,709 | 2,607 | 8 | 414 | 512 | 609 |
| India | 5,516 | 1,971 | 1,792 | 368 | 740 | 2,838 | 129 | 170 | 560 | 859 | 348 |
| Burmah | 16 | 22 | 23 | 47 | ... | 213 | ... | ... | 100 | ... | ... |
| Ceylon | 166 | 285 | 227 | 8 | ... | ... | ... | 3 | 41 | 31 | ... |
| Zanzibar, British East Africa and Mauritius | ... | ... | 3 | 3 | ... | ... | 17 | 10 | 9 | ... | ... |
| Straits Settlements | 25 | 48 | 190 | 19 | 460 | 152 | 5 | ... | 18 | ... | 2,100 |
| Hong Kong | 84 | 167 | 138 | ... | ... | 108 | ... | ... | 6 | 311 | ... |
| West Australia | 186 | 361 | 613 | 121 | 94 | 113 | 48 | 3 | ... | 8 | 18 |
| South Australia | 254 | ... | ... | ... | ... | ... | 8 | ... | ... | ... | ... |
| Victoria | 101 | 2,391 | 128 | 5 | ... | 162 | 52 | 3 | ... | ... | ... |
| New South Wales | 493 | 211 | 73 | 546 | 6 | 1,703 | ... | ... | ... | ... | ... |
| Queensland | 5 | ... | .... | ... | ... | ... | 26 | 36 | 2,912 | 7 | ... |
| Tasmania | ... | ... | 28 | ... | 340 | ... | ... | ... | ... | ... | ... |
| New Zealand | 120 | 1,917 | 304 | ... | 95 | 5,814 | 5 | ... | 12 | ... | ... |
| British West Indies and British Guiana | 13 | ... | 24 | 81 | ... | 244 | ... | 7 | ... | ... | ... |
| Canada | 50 | ... | 66 | 185 | 29 | 501 | ... | ... | ... | ... | ... |
| Total | £16,042 | 15,196 | 7,709 | 2,127 | 4,196 | 28,812 | 4,649 | 404 | 10,722 | 5,643 | 3,265 |

### Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Various countries, mainly as above. | 1,197 | 1 | 372 | ... | 14 | 7,009 | 10 | 32 | 1,667 | 100 | ... |

### Registered Imports into the United Kingdom of Electrical Goods from all Countries.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Russia, Sweden, Norway and Denmark | 82 | ... | ... | 20 | ... | 2,499 | 9 | ... | 13,471 | ... | ... |
| Germany | 6,005 | 1,957 | 596 | 145 | ... | 2,208 | 241 | 290 | 1,639 | ... | ... |
| Holland | 9,636 | 1,614 | 36 | ... | ... | 5,080 | ... | 4,719 | 6 | ... | ... |
| Belgium | 7,199 | 702 | 81 | ... | ... | 5,492 | 46 | 510 | 1,044 | ... | ... |
| France | 6,071 | 2,007 | 412 | 354 | 156 | 1,793 | 1,090 | 1,881 | 1,928 | ... | ... |
| United States | 5,583 | 6,450 | 138 | 1,268 | 570 | 16,012 | 5 | 4 | 541 | 700 | ... |
| Canada | ... | ... | ... | 3 | ... | ... | ... | 30 | ... | ... | ... |
| Total | £34,576 | 12,730 | 1,263 | 1,790 | 726 | 33,084 | 1,391 | 7,434 | 18,629 | 700 | 0 |

TOTAL EXPORTS: £98,965.

TOTAL RE-EXPORTS: £10,402.

TOTAL IMPORTS: £112,323.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

## PARLIAMENTARY.

### Administrative County of London and District Electric Power Bill.

(*Continued from page* 510.)

At the opening of the Committee on Tuesday last week, the Chairman said that, in view of the enormous size of the area proposed to be supplied by the promoters, he thought that any decision they might come to would create a precedent for the future. Therefore, to assist the Committee, he would ask all counsel engaged in the Bill to agree to have a return prepared on the following lines:—A list of companies authorised to supply electric power in districts in which companies and local authorities were already supplying electricity under Act of Parliament or provisional order; (*a*) the dates on which such authorisation was given in each case; (*b*) the area of supply, capacity and amount of supply now being given by such companies; (*c*) the names of the other companies and local authorities above referred to, their capacity, and the amount of supply now being given by them; (*d*) whether their actual supply has increased or diminished since the establishment of the new power companies in each case.

Counsel agreed to confer and submit such a statement as the Chairman indicated.

The cross-examination of Mr. Merz was then continued by Mr. Moon, K.C., on behalf of the Westminster Electric Supply Corporation.

Examined on the question of cost, the Witness said they expected to produce their electricity at a cost of ·507d. per unit, and to sell it at ·7d. per unit, which would give them a margin of ·193d. per unit. He thought that was a fair margin to play with. If they got that margin, they could pay 6 per cent. If they could not, their dividend would drop by 1 per cent. for every ·03d. that their expenses exceeded their estimate. Of the 137½ million units they estimated to supply, 82 millions would have to be supplied to authorised distributors. He believed that local authorities and companies would prefer to take their power from his company, because of the price at which they would be able to supply. The field they were proposing to deal with was not at present supplied, and if it was to be supplied, it must, to a large extent, be through a fresh installation.

Supposing the Central Co. have a site available, or acquire a site for putting up a fresh installation, why cannot we do it at a cost of not more than £10·5 per kw. if you can?—If you put it up the same size you could, I suppose.

And in the same way with the generating cost—what discovery have you got which enables you to generate electricity at a less price than anybody else?—None at all.

Then if we have a site which is equally available for manufacturing electricity, we can do the same thing as you and for the same price?—I am not aware that you have got any scheme for doing it. Continuing, witness said he understood that the South Metropolitan Co. had got a site on the river bank quite close to where they were proposing to erect their station. He did not know what was to prevent that company from doing what they proposed to do at the same cost, but the fact remained that they had had the opportunity for five years and had not taken advantage of it. As to whether it was not to the interest of an existing company to supply energy for power purposes at any price in excess of what it cost them to generate it, witness said that must be a question of policy. Personally, he did not consider it would be good commercial policy to supply power at the mere generating costs.

Replying to Mr. Vesey Knox for the Southwark Borough Council and other local authorities, Mr. Merz said he agreed that the percentages of the total power installed in London and in the Tyneside area were about equal. The relative population of the two areas was six to one in favour of London. He believed that except in the County of London there was no case of actual competition in electric supply throughout the United Kingdom.

In answer to the Chairman, Counsel said that the view of his clients was that the promoters were more vigorously opposing the local authorities than the companies, because in the non-industrial area, where there was to be no competition and power supply to individual consumers, these were practically all companies. In the industrial area, however, where there were mostly local authorities, by competing for the supply of power, the effect of the new company would be to keep the works cost of the existing companies at a high figure, and so eventually the tendency would be for people to take the whole of their supply from the big company, and in the end a monopoly would be created which would be against the interests of consumers.

Answering Mr. Roger Wallace, K.C., for the Kensington and Knightsbridge Co. and the Notting Hill Co., the Witness said he was aware that those companies had a joint station in the West End, but he did not think it would be possible for them to supply railway companies at a price that would warrant them taking their power from them.

On Wednesday last week Mr. Merz was still further cross-examined, and in reply to Mr. M. White (counsel for the Hackney Borough Council), said he would be perfectly willing to supply Hackney with current at the prices he had mentioned in his estimate.

In re-examination by Mr. Fitzgerald, Witness said he thought it would be impossible to erect generating stations if they had to comply with the London Building Act. Railway companies were exempt from some of the building bye-laws, and he believed this was also the case with some of the gas companies. With regard to the supply by the St. Pancras Borough Council of power at 1d. per unit, he worked it out that by adding the proper capital costs the generating cost came to 1·65d. As to the suggestion of the London companies that they could supply as cheaply as the new company, he would point out that only quite recently the Metropolitan Electrical Supply Company's best offer to the Marylebone Borough Council was 3d. per unit for the first two hours, and ¾d. per unit afterwards, which gave an average price of 1·7d. per unit. Without doubt the new company could supply at half that price. The terms for hiring out motors at Tyneside were about half those asked for by the Metropolitan Electric Supply Company in the case of direct-current motors, and about one-third in the case of alternating-current motors. His estimates were based on tenders.

In answer to Lord de la Zouche, Witness said the promoters put in the clause authorising the company to purchase undertakings and take transfers, because they realised that many of the London undertakings were in an unsatisfactory financial position, and it would be better for the ratepayers probably, if the company took the transfer and supplied the whole of the current.

The Hon. C. A. Parsons was next called, and said the main points of his evidence was as to the cost of generation. He contended that increasing the size of the turbines to the extent suggested, was the only possible means of carrying out the scheme. For instance, a 1,000-kw. turbine cost twice as much per kw. as a 10,000-kw. turbine. Witness had a number of models of turbines which he explained to the Committee, and pointed out the advantages of the use of large turbines as regarded floor space. The space taken up by a big machine was practically no more than a small one. The 10,000-kw. turbine generators had a maximum capacity of 20,000 kw. The steam consumption was 13 lb. per kw. against 15·4 lb. with the smaller sized machines at Newcastle. One of the main disadvantages of nearly all the London generating stations was the necessity for using cooling towers, which was a cause of inefficiency.

In cross-examination, Witness admitted that no 10,000-kw. turbines had yet been used, and that the normal capacity of the largest turbine yet made was 3,500 kw, only two of which had been built. The 10,000-kw. turbines proposed were 18 per cent. more efficient than the 3,500-kw. turbines. The overload capacity would be capable of use for periods varying from half an hour to a day. The period of construction of these 10,000-kw. turbines would be nine months.

Replying to Mr. Munro (who represented the St. Pancras Borough Council), Witness said he did not know that the 1,000-kw. turbine supplied to them had been unsatisfactory, and that the actual test had shown the steam necessary to generate a full current was 1,000 lb. per hour more than the guarantee.

In re-examination after the luncheon interval, Witness said he had discovered that the test referred to by Mr. Munro was not an official test. The machine was not yet out of the makers' hands, and proper condensing plant had not been used in the test.

Mr. C. E. L. Brown, of the firm of Brown, Boveri & Co., endorsed the evidence of Mr. Merz as to the estimates. He had made out an estimate for the cost of a large station on the Continent, and arrived at a cost of between £7 and £7 10s per kw., excluding land.

In cross-examination, Witness said his estimate was based on overhead wires. If underground wires had to be used, the price would go up.

Mr. S. Z. de Ferranti also agreed with the estimates of Mr. Merz. He said he had been over more than 100 miles of the route where it was proposed to lay lines. Witness proceeded to deal with the various generating stations in London in detail to show the disadvantages they all suffered from, both in site and design. In most cases there was no room for an extension of the stations, as the neighbouring land was all taken up. He enlarged on the disadvantages of cooling towers, and put in a photograph showing the Metropolitan Electric Supply Company's station at Willesden, practically enveloped in a fog from the steam given off from the cooling towers. Individually the London stations could not give anything like the supply proposed in the Bill, and collectively it was impossible, on account of the variety of systems in use.

In cross-examination by Mr. Balfour Browne, Witness said that the generating station at Deptford of the London Electric Supply Corporation, which he had stated was a bad one, was designed and erected by himself. The scheme, however, which he originally proposed was not carried out by the company owing to want of money; but if that scheme had been carried out, the station would have been a much better one. He disagreed with the principle of excluding any authorised distributor from power Bill areas, and from that point of view he had never considered the Lancashire and the Yorkshire Bills to be power Bills at all, because the companies in those cases were only authorised to supply to existing undertakers. He deprecated competition by two power companies over the same area, but considered that competition was quite possible between a power company and a small lighting company without any harm to the latter. Practically speaking, he believed that in time all the existing undertakers would become distributors of the big power companies' current.

Mr. Balfour Browne: And then you must get a monopoly.

Witness: Only a monopoly of cheapness.

In re-examination, Witness expressed the opinion that the principle of restriction forced upon the Lancashire and Yorkshire Power Cos. had been the reason why they had been backward in making a start.

At the opening of the proceedings on Thursday last week, the Chairman of the Committee stated that it had been brought to his mind that he was interested in one of the petitioners against the Bill—the South Metropolitan Gas Co. He would, of course, take no part in any decision of the Committee relating to that company,

although he understood that the only point was the taking of some property.

The Hon. J. D. Fitzgerald remarked that the parties were considering that matter, and he hoped that arrangements would be made so that the Committee should not be troubled with it.

Mr. Vincent Raven, chief assistant mechanical engineer to the North-Eastern Railway, was then called. He had had experience of the electrification of railways in connection with the transformation of part of the North-Eastern Co.'s system. In that case the company had considered the question of erecting their own generating station, and decided against that course. They took their power from the Newcastle Power Co. The electrified part of the system covered over 36 miles, or 90 miles of single track. He did not think that the London railway companies could make the change from steam to electricity with advantage unless they could get electricity for less than ¾d. per unit.

Cross-examined by Mr. Freeman, K.C.: He knew of no large railway company, either on the Continent or in America, which took its power from a power company. He was aware that all the tube railways of London generated their own power.

Re-examined: The London tube companies had their own generating stations, because they had no option in the matter. Possibly they would not have done so had the promoters of this Bill been there.

Mr. Gooday, general manager of the Great Eastern Railway Co., said that if it were decided to electrify the suburban part of their line, they would like to have the option of taking their supply from the promoters. If they electrified their suburban system, they would require rather more than 30,000 H.P. Taking the power from a company would save them considerable capital outlay.

Cross-examined by Mr. Ram, K.C.: He did not know what the price charged by the power company would be.

Mr. Berry, the manager of the Great Northern Railway Co., said that the suburban traffic of that line was about 100,000 passengers per day. The company had had the question of electrification before them for some time, and from preliminary estimates they had found that the cost of erecting a generating station would involve 35 per cent. of the total cost of electrification. The advent of this company would greatly facilitate the electrification of the line, which, if carried out, would require about 26,000 H.P.

In reply to Mr. Ram, Witness said that his position was the same as that of the previous witness.

Mr. Cuningham, general manager of the Central London Railway, in the course of his evidence, said that at Montreal, where he was engaged in the electrification of the street tramways, he had had some experience of the working of condensing and non-condensing plant. The water for condensing was taken from a canal, and when the water in the canal was run off, the plant had to be used without the condenser. He found that without condensing the cost of working increased 30 to 35 per cent.

By Mr. Ram: *Ceteris paribus*, he admitted that it was better for a railway company to have its own generating station.

Mr. F. E. Gripper, manager of the Edmundson's Electricity Corporation, gave evidence as to the advantages of large over small installations, and a number of representatives of engineering firms who would take power were called in support of the scheme.

After several witnesses had been called, Earl Camperdown asked how many more witnesses of that character were to be called.

Mr. Honoratus Lloyd: "Forty-five, my Lord. They are coming from all parts of the area."

After some discussion, Counsel said that he would call two of the witnesses only. These having been examined, evidence on the financial side of the scheme was given by Mr. Falconer, one of the promoters, who said that each of the promoters had subscribed £500 towards the preliminary expenses. If necessary, they were prepared to find the whole of the capital. Mr. G. Farrer, managing director of Baring Bros., also gave evidence.

On Monday the first witness called was Sir Alexander Binnie, who gave evidence as to the estimates for street works. He considered that the estimates were reasonable, and that having the ring main on the proposed route would minimise inconvenience. The less crowded streets had been chosen.

Cross-examined by Mr. Vesey Knox: Witness said that he had not gone into the cost of the generating station except so far as the foundations were concerned. He could not give an opinion as to the cost per KW.

Re-examined: The promoters considered that the proposed route of the ring main was the best they could have, but they were willing to meet the views of local authorities in regard to any deviations which they might suggest.

Mr. Stenning, F.R.I.B.A., F.S.I., was called on the question of the cost of the buildings. He thought that the amount provided was ample for all requirements, and that the buildings should be put in the same category as those of gas companies, which were exempt from the operations of the Building Act.

Cross-examined by Mr. Lewis Coward, K.C. (for the London County Council): The promoters had inserted a special clause relating to the buildings, because the L.C.C. might raise objections which would delay the erection of the buildings.

Mr. Mebz, recalled on the question of the areas of supply, said that the industrial area had been selected on account of the large number of factories in that area.

In reply to Mr. Rigg (for the Corporation of London), Witness said that the promoters would be quite willing to discuss the route of the proposed mains through the City.

Mr. Rigg: Yes; but after you have got your Bill. Witness: Certainly. Certainly.

By Mr. Vesey Knox: Such districts as Bromley had been included because of possible factories in the future. He considered that the use of overhead distributing wires was perfectly safe. The laying of the ring main would depend upon how the scheme developed, but his supposition in the estimate was that no main would be laid outside the industrial area until after 1910.

This concluded the case for the Bill.

Mr. Neville, K.C., then addressed the Committee on behalf of the nine companies who presented a joint petition against the Bill. He said that he did not propose to deal with the evidence, but would confine himself to the policy of the Bill. The companies which he represented had together a very large capital, something like £8,000,000, besides a considerable amount of unissued capital. He did not say that there should be no competition, for the question of monopoly was dealt with by the Act. What his clients said was that the proposed competition was not in any sense such a competition as was provided for by the Act. The promoters of the scheme asked to be placed on a different footing, and to be placed over the heads of the companies on conditions very much more favourable. He did not think that the London companies could be accused of want of push or want of energy, but taking the whole of the dividends paid by them up to 1904, the average was only 4 per cent. on their paid-up capital. They had 26 years more of their term to run, and they would have to put themselves in a position to recoup their capital. If allowed to go on without competition they would, no doubt, become good going concerns, but here was this large company saying, "No; all the improvements to be had we are going to get," and on much more favourable terms. Practically, it meant reaping the rewards of the companies.

The Chairman: Is that quite what they say?

Mr. Neville: Well, that is my interpretation of what the result will be.

Continuing, Counsel said it was not like coming to a large area which was not supplied at all, but coming to an area already fully supplied by local authorities and companies. It was asking Parliament to do something which had never been done before. Another point was that the promoters of this Bill would be limited in their liability to supply, for they would practically be able to pick their customers. On consideration, he contended, it would not be fair to grant them their powers. What they believed was, that in the end they would succeed in ousting the existing companies as generators of electricity altogether.

The Chairman: I think "ousting" is rather a strong term. (To Mr. Charteris), I think that what you expect to do is to supplement the existing companies as generators?

Mr. Charteris: Yes, my Lord, as generators.

Continuing, Mr. Neville said that *qua* generators the company would acquire a monopoly of the whole of London. It would really be a trust and would operate against the public interest. Competition would be a physical impossibility, as the streets would be too crowded with mains to allow of the addition of any more. If Mr. Merz's suppositions were not realised a great deal of harm would be done.

The Chairman: But if the company succeed in compelling the existing companies to scrap their stations they would still have no power to distribute power for lighting direct.

Mr. Charteris: That is so.

Mr. Neville: Yes, but public lighting is an exception to that.

Mr. Moon: The local authority would be considered as distributors for the purpose of public lighting.

Mr. Neville, in conclusion, reviewed the evidence shortly. He ventured to think that the evidence as to a public demand had been very weak. They had had one case mentioned, that of Mr. Nightingale, which was a case of the supply of electricity for a crane, and was a matter of £10 or £12 a year. He would, in conclusion, ask the Committee to say that it would not be fair to give the promoters their Bill.

Mr. Conacher, the general manager of the Metropolitan Electric Supply Co., Ltd., was then called. Examined by Mr. Balfour Browne, K.C., he explained at some length the history of the various companies petitioning against the Bill. The total capital of the nine companies was £11,299,000, out of which £7,562,000 had been spent up to the present. The companies had many obligations of an onerous nature. They were compelled to give a supply to anyone who demanded it, while in the country no person could call upon a company to supply in a non-compulsory street. The companies were also under an obligation to supply any street lamp within 75 yards of one of their mains. It was a hardship on the companies that they should have to keep up their concerns right up to the day that they were bought, although they would not be taken over as going concerns. In 1900 the number of units supplied by the whole of the companies was 54,250,000, and it had risen until last year it stood at 111,425,000. All the companies had generating plant much in excess of the present demand. The total capacity in kilowatts was 119,339 KW., while the largest demand had been 78,408 KW.; that was a margin of 50 per cent. nearly. Most of the stations were on sites which provided for considerable enlargement. In the case of the Willesden station of his company, they had at present a plant of 13,800-KW. capacity; and 3,000-KW. plant was being laid down, but they had room for at least six times the total amount, or 100,000 KW. The Committee adjourned.

At the commencement of proceedings on Tuesday, the Hon. J. D. Fitzgerald, K.C., for the promoters, referred to certain criticisms which Mr. Neville had passed on the previous day on the question of maximum prices. He thought that there was a certain ambiguity in one of the clauses, but the intention was that the maximum prices should be real, and not sham prices. He would be willing to alter the wording of the clause.

The Chairman said that the Committee did not propose to go into details at that moment.

The examination of Mr. Conacher was then resumed.

The Chairman called witness's attention to the fact that on the previous day Mr. Neville had stated that the terms upon which the

promoters of the present Bill would supply were different from those on which his (witness's) company supplied. He (the chairman) would like to see one of the prov. orders under which the company supplied.

Mr. Ram said that his Lordship should have a copy.

Mr. Moresby White, on behalf of Hackney, offered a copy of the prov. order under which that local authority supplied.

The Chairman thought that he would wait until the case of the local authorities came up, when counsel could state a general case for the local authorities.

Examined by Mr. Ram, Mr. Conacher said that for years the companies had been awake to the fact that it was desirable to have large stations. They were fully alive to the advantages of concentrating their business.

By the Chairman: They were actually "scrapping" some of their stations.

In the case of his company, he anticipated that by next year the whole of the supply would be given from the Willesden station. All the companies had, in addition to enlarging their business, very greatly increased the size of their machinery. The 1,500-kw. machines at Willesden had had to be obtained in the United States, as it was not made in this country. For some time past the companies had been anxious to promote business either by low rates or by a sliding scale.

The Chairman: But there is nothing about a sliding scale in the Act.—Witness: No; that is simply by agreement.

The Chairman: The difference between you and the promoters is the basis on which the sliding scale is made? The Witness replied that that was so. The difference was that while, in the case of the companies, the sliding scale was made by agreement, the promoters of this Bill proposed that the sliding scale should be part of the Act. Continuing, witness said that he considered that the promoters would be able to pick and choose their customers. The scheme of the promoters was quite inapplicable to the proposed area.

Cross-examined by the Hon. J. D. Fitzgerald: He did not deny that the maximum charges in this Bill were considerably lower than the maximum charges of the companies He considered that they were too low. Questioned as to the prices paid for coal by the companies, he said that he was aware that, while the companies paid 12s. per ton for coal, the promoters estimated on paying 8s. per ton. If a company abandoned its own generating station it might be to its advantage to take a supply of power from a large generator.

The Hon. J. D. Fitzgerald: But it is, obviously, to their advantage to have the option of a supply?—Oh, I don't object to that. Under certain circumstances it might be so.

As a matter of fact, you are promoting a Bill to enable you yourselves to supply in bulk over a very large area?—Yes.

Mr. Fitzgerald then took the witness at some length through the conditions under which the various companies supplied. In the case of the Westminster Co., he considered that they would be affected most in the matter of street lighting. The City Council of Westminster had no power to generate electricity, so that they had to take their current from the Westminster Co. They were, of course, large consumers, and if this Bill passed there would be direct competition. He admitted that there was very little current used for power purposes in Westminster. Witness was not able to give the figures for works cost, &c., in the case of some of the other petitioning companies, and counsel suggested that the figures had been asked for a week ago.

Witness said that the letter asking for the information had been passed on to the Parliamentary agents who had the case in hand.

Mr. Fitzgerald: And they advised you not to reply to the questions.

Re-examined by Mr. Neville, K.C., Witness said that he considered that the greatest competition would be in the industrial area. As to the option of taking a supply, its advantage depended upon the price they had to pay for it.

Mr. Hordern, general manager of the Westminster Electric Supply Corporation, examined by Mr. Neville, said that his company considered they could supply all the electricity required in their area. They had recently erected a large generating station in Duke Street. His company, as was the case with the other companies, made special charges to large consumers, such as hotel companies, &c. During the last five years there had been a fall in the price of electricity of 10 per cent. By 1910 there might be another 10 per cent. off. He looked forward to a substantial increase in the diversity of load. The company did not make a profit on its supply to small consumers, who, he thought, would be prejudicially affected by the Bill as it stood. His experience had always been that a reduction in the price for lighting was always followed by an increase of business.

The Committee adjourned.

On Wednesday Mr. Hordern handed in a table which he said showed that the Westminster Co. were now supplying at a price lower than that proposed by the Bill. Evidence was also given by Mr. R. Stewart Bain, for the London Electric Supply Corporation; Prof. Kennedy; Mr. H. W. Sprunt, for the South London Electric Supply Corporation; Major Cardew; Mr. Seale, for the Charing Cross Co.; and Col. Crompton. This evidence will be reported in our next issue.

*(To be continued.)*

## Swansea Corporation Bill.

On Tuesday and Wednesday last week, Mr. F. W. Stevenson's Select Committee of the House of Commons, considered the Swansea Corporation Bill, Part II. of which sought to authorise the Corporation to acquire the undertaking of the Swansea Tramway Co., whose shares are practically held by the B.E.T. Co.

Mr. H. Lloyd appeared for the Corporation, and dealing with Part II. of the Bill, said that the Swansea Tramways Act of 1882, in Clauses 34 and 35, contained provision in relation to the purchase of the tramways by the Corporation, and the granting of a lease to the company. The Swansea Tramway Co. were incorporated by Act of Parliament in 1874, and were authorised to construct certain tramways in the borough. In 1878 the company, under another Act, got further powers to construct tramways, and again, in 1879, by Provisional Order, they got still further powers. In all three of these Acts the company were subject to the provisions of the Tramways Act of 1872, which gave the Corporation power to purchase at the end of 21 years, or in any future periods of seven years. In 1882, however, the company came for further powers, and an Act was passed which gave them these powers. One of the clauses of that Act gave the Corporation the right to themselves construct the tramways, and also the power, within 12 months, for the Corporation to purchase the lines, if the company constructed them. At this time the position was that the 1874 tramways were purchaseable by the Corporation in 1895; the 1878 tramways in 1899, and the 1879 tramways in 1900. In 1882 the Act was passed containing the following clauses:—

Clause 34.—If the Corporation construct or purchase the tramways, or any part thereof, or if they purchase the tramways authorised by the Act of 1874 or the Act of 1878, or the Order of 1879, or any one or more of them hereafter referred to separately as an existing tramway, and collectively as existing tramways, the following provisions shall have effect:—(1) The Corporation shall upon application grant the lease of the tramways so constructed or purchased, and of the existing tramways so purchased for such term not exceeding 21 years as the company require, and at such rent and upon such terms and subject to such conditions as may be agreed on between the company and the Corporation, or as, failing agreement within two months after such application, shall be settled by a referee appointed by the Board of Trade. (2) If the Corporation elect to construct or purchase as aforesaid, they shall be subject to the provisions, and shall perform and observe all the obligations and conditions imposed on the company with respect to the construction and maintenance of such tramways as they so elect to construct or purchase, in the same manner and to the same extent and effect as if the Corporation had been authorised to construct such tramways and had been named in the Act authorising such construction instead of the company.

Clause 35.—The Corporation shall not purchase any of the tramways or existing tramways otherwise than by agreement with the company during the subsistence of any lease granted by the Corporation to the company, or in case there be no such lease, until the expiration of 21 years from the completion of the tramways, and if the Corporation purchases the tramways or any part thereof or any existing tramway, they shall also purchase the lands, buildings, &c.

He suggested that it was the obvious intention of Parliament in the Act of 1882, and of all parties, that for general convenience the company should have 21 years absolute ownership from that time, in order that they might develop their undertaking before the purchase clause operated, whilst at the end of that time the company might, if they desired it, have a lease for 21 years. The tramways authorised in 1882 were completed in 1885, and therefore the 21 years expired in February, 1906. The gist of his case was that it was understood by everybody that this was the position of affairs, and that the clauses in the Act were drafted with a view to bringing that about. In 1897 there were two Bills before Parliament. The Corporation had come to a provisional agreement with the Tramway Co. for the purchase of the undertaking, and they promoted a Bill to get Parliament's sanction to such an agreement. Unfortunately, it was contended that the Corporation had not properly complied with the provisions of the Borough Funds Act, and the Bill was thrown out. The Tramway Co. promoted a Bill in the same session of Parliament to enable them to raise £50,000 capital and to electrify the existing tramways. Up to 1897 there was no difference between the Corporation and the company, but at that time the majority of the shares were purchased by the B.E.T. Co., and apparently the advisers of the company began to see whether they could not put some different interpretation upon the sections. The result was that the company claimed that what had been sworn to be their view up to that time was not the real meaning at all, and they said that what it meant was that, in the first place, the Corporation could buy nothing for 21 years; that at the end of the 21 years they could purchase such portions as happened to fall in and then grant a lease for 21 years to the company, and during that period they could purchase no more; then at the end of this 21 years they could purchase such other portions as fell in and again grant a lease, and so on. The result of their contention was that the Corporation could not purchase the tramways until 1993. The Corporation considered the contention ludicrous and went to the Court of Chancery. The Court, however, would only deal with the meaning of the words as they stood, and without inquiring into the intention, decided in favour of the company. Under these circumstances the Corporation asked that the clauses should be repealed, so that the obvious intention of Parliament should be carried out.

Mr. Thomas (Town Clerk of Swansea) was called, and said the Corporation did not oppose the company's Bill in 1882 on the understanding that the whole system of tramways would remain in the company's hands, until 20 years after the completion of the tramways authorised by that Bill. The object was to bring all the different lines of tramway into line and treat the whole thing as one concern.

Mr. Balfour Browne, K.C., addressed the Committee for the Tramway Co., and said that when the whole thing was boiled down, what it amounted to was that the company asserted one interpretation of the agreement, and the Corporation another. The Corporation said the agreement was not carried out, while the company said it was, and, what was more, the Court of Chancery had decided in the favour of the company. The Court of Chancery gave the company possession of the lines for 90 years, while the Bill asked Parliament to take them away in 1906. Whatever might have been said by counsel in previous Bills, could not take away his rights. The Corporation said they understood something different by the clauses, but they should have understood it when those clauses were before Parliament. It was on the strength of

the clauses that the British Electric Traction Co. purchased the undertaking.

In answer to the Chairman, Mr. Balfour Browne said the Traction Co. purchased the undertaking before the decision of the Court of Chancery.

Mr. E Garcke, of the British Electric Traction Co., was called, and said his company purchased the shares of the Swansea Co. in 1898. It was done on the strength of the clauses.

The Chairman: It is stated in your petition against the Bill that £345,000 has been spent upon the undertaking, of which sum £80,000 represents the expenditure on streets and street improvements, while the cost of adapting the tramways for work by electricity was £140,000. Was that £80,000 spent in the earlier days?

Witness said it was spent before the British Electric Traction Co. acquired the undertaking.

The Committee considered their decision in private, and on the resumption of the proceedings the Chairman declared the preamble not proved, and this portion of the Bill will accordingly be struck out.

---

### Weybridge and Walton on-Thames Electric Supply Bill.

This Bill came before Mr. Agg-Gardner's Select Committee of the House of Commons on Thursday last week.

The case for the promoters was opened by Mr. Claude Baggallay K.C., who stated that the Bill was promoted by the Urban Electric Supply Co. In the year 1900, the promoters of the present Bill obtained the Weybridge Electric Lighting order to which the local authority of Weybridge gave the necessary consent. The consent, however, was given subject to an agreement that the charge by the company for all electric current required by the Council for public purposes should not exceed the price of 4 d. per unit, and that the site for any generating station erected in the district should be such as should be approved of by the Council. It did not necessarily follow that the generating station would be in the district at all, but if it was in the Weybridge district the site would have had to be approved by the Council. After the order was granted and confirmed, the site of the proposed generating station was selected in the Weybridge district and approved of by the Council; the station was erected and had been in use ever since. In the year 1903 the Walton-on-Thames Urban District Council, whose area adjoined that of Weybridge, obtained an electricity order, but they did not erect a generating station in their district. What they did was a very common thing in practice, they made a contract, under the Act of 1882, to take a supply from the Urban Electric Supply Co.'s, Weybridge station. For some reason, the Weybridge Urban Council did not like that arrangement and put themselves into communication with the Board of Trade. The matter was inquired into and it was found that the company was committing a fault under the Electric Lighting Clauses Act, which was incorporated with the Weybridge order of 1900. That Act stated that the undertakers shou'd not associate themselves with any company or person (and "person" included the Walton-on-Thames District Council) supplying energy, under any licence, provisional order, or Act, unless the undertakers were authorised by Parliament to do so. The Board of Trade wrote to the company in August, 1903, saying that unless the promoters satisfied them that they were complying with the various Acts, they (the Board of Trade) would have to consider whether they would not have to revoke the Weybridge Order. The company, thinking that they could get rid of the technical objection, obtained the consent of the Walton Council, and applied to the Board of Trade for a provisional order for Walton. That was in 1903. Weybridge objected to that on the ground that the company could not supply Walton with energy generated in Weybridge, and in July of last year commenced an action for an injunction. They obtained the injunction in August, and it prevented the company from the exercise of any powers conferred by the Weybridge Order of 1900, until judgement or further orders. Between the granting of the injunction and the latter part of the year, a temporary generating station was erected at Walton-on-Thames without accumulators. On January 13th this year an order was made for a perpetual injunction, which was, however, suspended in order that the promoters might make this present application to Parliament. It was pointed out to Mr. Justice Joyce, before whom the case came, that until the matter was settled the company had erected only a generating station in Walton, and had not gone to the expense of putting in accumulators, and that, therefore, it was very desirable to have two things. One, the supply from Weybridge in Walton after midnight until the next afternoon, or before sunset, in order to save the running of the two stations during those hours, and that was made one of the exceptions of the order. The other was that in the case of a breakdown or other emergency at other hours, although it might be during the ordinary hours, between one hour before sunset and midnight, Weybridge might supply energy into Walton. Learned counsel doubted if it was possible to controvert his contention that the order was drawn up in that form with a view of letting the company see if they could get Parliament to pass their Bill. The present Bill was a very short one, of which Clause 3 contained the whole of the operative part. Shortly, it was to the effect that the powers of the promoters under their existing order and Acts incorporated therewith should extend to supplying energy from Weybridge into Walton. The population of the two areas was not large enough to make very remunerative undertakings when supplying from two stations. He believed that, by having one station, the promoters estimated to save something like £20,000 of capital expenditure and a considerable amount in working. Counsel then dealt at some length with the petition of the Weybridge Council.

Mr. Francis Edward Gripper was then called, and explained in detail the various negotiations which had taken place. Explaining the diagrams on the wall of the committee room, he said that it would be necessary further to enlarge the station at Weybridge in the near future. An extra engine and a boiler would be required. At the present time they were supplying in Weybridge about 18,000 lights of 8 c.p. each, although the station would be capable of supplying 40,000 lamps when they had put down an additional engine. If they supplied Walton, as they hoped to do, another engine and boiler would be necessary, which would give them a station capable of supplying 60,000 lamps.

On Friday witness was cross-examined by Mr. Honoratus Lloyd He admitted that in 1899 two attempts were made to supply Weybridge and Walton together, but objections being raised, the applications were withdrawn

Mr. Campbell Swinton, M.I.C.E., was called, and gave evidence of having seen the station at Weybridge. The houses roundabout were of the villa type, and would not be affected injuriously by vibration, they were too far away from the station for that, even if the station were large enough to cause any vibration.

Capt. Baxs, a director of the Westminster Co., considered that the scheme would be a great advantage to the district. He had canvassed some 30 ratepayers, of whom 20 were absolutely in favour of the scheme, three were against it, two were in favour, subject to conditions, four did not know enough about the question to give an opinion, and one would have been in favour of it, if the mains had passed his house.

Other evidence was called, and Mr. Honoratus Lloyd addressed the Committee on behalf of the Weybridge Council. The inhabitants of the district, he said, objected to having in their midst a generating station which would supply a district much larger than their own. He regretted that Mr. Justice Swinfen Eady, who was a resident in the district, could not tell the Committee what he considered of the scheme. Unfortunately, he was not able to be present.

Witnesses for the opposition were then called.

Mr. Bilner, solicitor, and late chairman of the District Council, repudiated the suggestion that the objection was due to any petty quarrel between Walton and Weybridge.

Mr. S. J. Du Cros, a member of the Council, and resident in Weybridge for over 30 years, said that it had always been the desire of Weybridge to be self-contained.

Mr. W. F. Ward, solicitor, who had in 1903 brought an action against the electricity company for nuisance, said that the smoke from the chimney was still sufficient to cause a nuisance, although the vibration had ceased.

Cross-examined by Mr. Tyldesley Jones: Witness said that when he visited the works in company with Mr. Grimshaw, the engineer who reported on the matter, they did not notice any vibration, because "the wind was blowing it the other way."

Mr. F. M. Favell, M.I.C.E., and member of the District Council, was also called.

Mr. James Swinburne, past-president of the Institution of Electrical Engineers, said that in the case of Weybridge desiring to purchase the station at some future date, it would find itself purchasing a station much too large for it. He admitted in cross-examination that he had in many cases given evidence as to the advisability of having one station for many districts.

The Committee at this point deliberated in private, and on the re-admission of parties, the Chairman of the Committee said that he would not trouble learned counsel for the promoters to reply on the evidence The Committee were of opinion that the preamble had been proved.

---

### Great Northern, Piccadilly and Brompton Railway (No. 1) Bill.

On Monday Mr. Compton Rickett's Select Committee of the House of Commons commenced the consideration of this Bill, which was opposed by the Thames Conservancy, the London County Council, the Westminster City Council, the Central London Railway Co., the Lambeth Borough Council, and the promoters of the Hammersmith, City and North-East London Railway.

Mr. Balfour Browne, K.C., who with Mr. Roskill and Mr. Clode appeared for the promoters, said the Bill in some aspects was a very important one. Some years ago a tube railway was authorised to be constructed from Finsbury Park underneath the Great Northern Railway, to terminate underneath the Strand at the end of Aldwych. The Brompton and Piccadilly Railway Co. was authorised to construct a tube railway from Earl's Court to Piccadilly. The two companies amalgamated under the title of the Great Northern, Piccadilly and Brompton Railway for the better carrying on of the objects they had in view, and a junction of the two lines was effected at Holborn. At one time there had been a dispute between the companies and the County Council as to the construction of the railway not being carried out until the new street of the County Council from Holborn to the Strand was completed. They had put into the Bill a clause authorising them to go on and construct their deviation at Holborn before that new street was completed, but he believed the parties had now agreed, and that a written agreement would be entered into allowing his clients to go on before that street was completed. When that agreement was signed the clause he had mentioned would be withdrawn. It was about this point that they proposed to cross the line of the Central London Railway, and he supposed the Central London Co.. was simply there to see that the work was properly carried out. There would, however, be no difficulty in carrying this out without interfering with the stability of the Central London tube. Then his clients

proposed to make two new railways. No 1 railway would carry the line underneath the Strand to Surrey Street, and No. 2 would carry No. 1 railway on underneath the Thames to Waterloo station. In connection with No. 1 railway there was a petition by the Central London Railway Co. Both the Central London Railway Co. and his clients had Bills before Parliament to carry tube railways under the Strand, but owing to the Traffic Commission not having reported these Bills were hung up. He wished to make it perfectly clear that his clients wished to do nothing under the Strand which would prevent the Central London Railway constructing a line if Parliament authorised them to do so. It was simply a question between engineers. With reference to the petition of the City and North-East London Railway, the promoters of that company were seeking to make a railway along the Strand, but they were unable to find the deposit money, and the company did not exist.

Mr. Vesey Knox said the Bill was not dead. In previous sessions the promoters had made the necessary deposit of consols, but this year it seemed very doubtful whether the Tube Bills would be allowed to proceed, and, therefore, advisedly they did not make the deposit of money. The Bill was still alive. All they asked was a clause to the effect that the Board of Trade in approving the selectional plans of the railway, should see that they were so prepared that it would not prevent the construction of another railway under the Strand.

The Chairman pointed out that the City and North-Eastern Bill was thrown out on Standing Orders.

Mr. Vesey Knox said that the Bill was not dead and it was competent for the House of Commons, in spite of the fact that the Traffic Commission had not reported, to send all these Bills to a Committee and suspend the Standing Orders.

Mr. C. T. Yerkes, chairman of the Underground Electrical Railways of London Co., was called and stated that this company was constructing the Great Northern, Piccadilly and Brompton Railway, the Baker Street and Waterloo Railway and the Charing Cross Euston and Hampstead Railway, and was electrifying the Metropolitan District Railway. They were putting up a power house at Lot's Road, Chelsea, to supply the electric current for all these lines. The Underground Railway were paid by shares and debentures in the concerns. They had spent £3,650,000 on the Great Northern Piccadilly and Brompton Railway, and they hoped to be ready for the travelling public in 18 months. Ninety-five per cent. of the tunnelling work had been completed. Contracts would shortly be made for the rolling stock. They had made provision for carrying 65,000,000 passengers per annum, and had facilities for carrying over 80,000,000 on the line. There was a mileage of about nine miles. At present there was authority to charge 2d. from Finsbury Park to the Strand, and 2d. from Earl's Court to Piccadilly Circus. By this Bill the company took power to charge 2d. over the extension, but no doubt if the traffic justified it, a uniform fare of 2d. would be made. The capital of the Underground Electric Railways Co. was £5,000,000, of which 50 per cent. was paid up. They had also, under what were termed profit-sharing notes, realised £7,000,000, and had sold about £2,000,000 other securities. These profit-sharing notes were collateral security for money advanced, and there was an agreement by which if the shares were sold above a certain price the holders of the notes took half the enhanced price. There has been a public issue of £1,200,000 4 per cent. debentures by the bankers of the Great Northern, Piccadilly and Brompton Railway, which now stood at a premium, but there had been no issue of ordinary stock. He estimated that the journey from Finsbury Park to Earl's Court, would take about 45 minutes, and from Finsbury Park to Waterloo 35 minutes.

Mr. Alex. Ross, engineer of the railway, also denied that there was any intention to prevent another railway under the Strand. He was not prepared to allow the matter to go to the Board of Trade. The line under the Thames was to be a single line, worked on the shuttle system. The cost of the new railways was estimated to be £329,490. The Committee adjourned.

On Wednesday the preamble was passed subject to the insertion of the following clause to meet the Committee as to the single line from Surrey Street to Waterloo station:—"Provided that railway No. 2 shall not be opened for traffic unless and until an additional tunnel has been constructed so as to provide separate tunnels for up and down traffic."

---

### Charing Cross, Euston and Hampstead Railway.

The Bill promoted by this company came on last week before a Select Committee of the House of Commons, presided over by Mr. Compton Rickett. The only opposition came from the Westminster City Council, who were averse to the idea of a station opening straight into such a crowded thoroughfare as the Strand. After lengthy discussion on this point, the Committee adjourned until Monday. The Committee were desirous of giving the company an entrance in the Strand, but they could not sanction any stairway of less than 8 ft. in width.

On Monday the Committee concluded their consideration of the Bill, when Mr. Yerkes, chairman of the Underground Railways of London, was called, and described plans which would allow of an entrance and staircase of 8 ft. being made from the Strand to the station.

The Chairman asked witness if, looking to the future development of such an important station as Charing Cross, he thought a single entrance and staircase of 8 ft. would be sufficient. Witness said he did, because there was also an exit, and an 8-ft. entrance with a stream of traffic going one way would be quite sufficient.

The Committee passed the preamble of the Bill, and also the clause approving of the plan of Mr. Yerkes.

On Wednesday, certain plans dealing with the forecourt of Charing Cross station and the size of the entrances were signed by the Chairman, and will have to be complied with by the promoters. A clause was inserted for the protection of the Gordon Hotels Co., providing that no main wires, cables, or other apparatus for the supply of electrical energy by or to the company shall be brought within 70 ft. of any of the premises of the company.

---

*Aberdare Tramways Bill.*—The Court of Referees on March 23rd had before them the objections of the Aberdare Urban District Council, who are promoting the Aberdare Tramways Bill, to a *locus standi* being allowed the Aberdare and Aberaman Gas Co. Mr. Shaw represented the Gas Co., who he said wanted to be heard on the question of the supply of electric fittings, and also wished a clause inserted in the Bill similar to that imposed on a number of local authorities obtaining electric light provisional orders last year. The effect of that clause was to make local authorities publish their accounts so as to prevent waste of the ratepayers' money. It was a modification of the clause inserted in the Aberdeen Tramway Bill a few years ago. The chairman disallowed the *locus* of the company.

*Metropolitan District Railway Bill.*—This Bill came on before the Lord Chairman of Committees in the House of Lords last week as an unopposed measure, and it was ordered to go forward.

*Tyneside Tramways and Tramroads.*—This Bill was before Lord Balfour's Committee of the House of Lords last week. There was no opposition, and it was ordered to proceed.

*Shropshire and Worcestershire Electric Power Bill.*—The Midland Electric Corporation for Power Distribution has withdrawn its opposition.

*Chelsea Electricity Supply Bill.*—This Bill came before the Chairman of Ways and Means on March 23rd as an unopposed Bill, and was ordered to be reported for third reading.

*Tyneside Tramways and Tramroads Bill.*—In the House of Lords on Monday, March 27th, this Bill was read a third time and passed.

*Metropolitan Electric Tramways Bill.*—In the House of Commons on Tuesday this Bill was read a second time and committed.

---

## OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

---

"Inquirer" writes:—"In a traction sub-station with motor-generators working at extra high-pressure, are there any regulations as to the necessity of two attendants being on duty simultaneously, or is one sufficient?"

*** So far as can be ascertained there is no duty cast upon those who are responsible for a sub-station to keep two persons in attendance. The Board of Trade have power, by virtue of Sec. 79 of the Factory Act, 1901, to make regulations for the conduct of dangerous trades; but electrical sub-stations have been dealt with under this head, and the memorandum embodying the special regulations was published in the Electrical Review for May 13th, 1904, p. 811.

---

"Sub-assistant" writes:—"In case of a sub-station attendant getting a severe burn while performing his regular duties, incapacitating him from his duty for a period of 10 days, can he claim from the company his wages and doctor's bill? Failing this, can he claim compensation."

*** It is clear that the Workmen's Compensation Act, 1897, applies to employment in an electrical station (Factory Act, 1901, Schedule VI. (20); W.C.A., 1897, Sec. 7 (2)), and that if a severe injury was sustained in the course of employment at a sub-station, a claim for compensation could be preferred. But the employer is not liable under that Act "in respect of any injury which does not disable the workman for a period of at least *two weeks* from earning full wages at the work at which he was employed." This excludes the employer from liability under the Act of 1897. With regard to the question whether a claim can be preferred at common law or under the Employers' Liability Act, 1881, this will depend on the facts of the case. In order to succeed in a claim under the Employers' Liability Act, 1881, the injured man must show that the injury was caused by a defect in the plant, or by reason of negligence on the part of a foreman or superintendent, or by reason of negligence on the part of anyone to whose orders the person injured was bound to conform; or by reason of the act or omission of any person in the service of the employer done or made in obedience to the rules or bye-laws of the employer, or in obedience to particular instructions given by any person delegated with the authority of the employer in that behalf. [See the Employers' Liability Act, 1881, Sec. 1]. The foregoing liabilities are subject to the conditions of Sec. 2 of the Act, and notice of the accident must be given in the manner prescribed by Sec. 4. The persons who own the sub-station might also be liable at common law, that is to say, independent of statute, but in view of the many technical defences which may be raised to that form of action, success would be problematical.

"O. H. B." writes:—"We are at present making negotiations in connection with the street lighting of a village in Ireland. The plant will be put down by a private individual, who will also fit up the lamp poles and run the necessary wiring, the arrangement being that the local authority will pay an annual sum for the use of the light.

"(*a*) Is it necessary to obtain a provisional order, and, if not, is it necessary to put the scheme before the Board of Trade for approval before putting the work in hand?

"The lighting will be done at a pressure of 250 volts, the wiring being run overhead.

"The lamp brackets are to be fixed to the poles carrying the overhead wires. The wiring would, of course, require to be kept at such a distance from the ground as to comply with the Board of Trade requirements.

"(*b*) If it is not necessary to communicate with the Board of Trade, is the consent of the local authority sufficient for the purpose?

"(*c*) Is it the case that any private person owning property in the village may veto the whole affair?"

*** With regard to (*a*), there is no need to obtain a provisional order in order to put up the installation in question. So far as can be seen, the scheme proposed will be in full accord with the regulations which have been made by the Board of Trade for the establishment of electric lighting systems which are laid down otherwise than under the terms of a provisional order.

"O. H. B." should consult these regulations, the proper title of which is "Regulations Prescribed by the Board of Trade under Sec. 4 of the Electric Lighting Act, 1888." They may be obtained from Eyre & Spottiswoode, London, E.C.

(*b*) If the mains are to cross any highway, the written consent and approval of the local authority should be obtained. This may not be absolutely necessary, but it would be well to obtain it.

(*c*) If it were absolutely necessary to carry the mains over or under the property of some person who objected, his opposition might be fatal. Otherwise a mere private owner would have no power of veto.

## THE AGRICULTURAL HALL MOTOR-CAR SHOW.

The Motor-Car Exhibition, which was opened on Saturday, March 18th, at the Agricultural Hall, London, N., forms the tenth of the annual series of such shows that have been organised by Mr. C. Cordingley, and it may be said at once that the Exhibition was by far the largest that has so far been held in this country, there being close upon 300 exhibitors. The show was under the patronage of the Automobile Mutual Protection Association, the Motor Van and Wagon Users' Association and the Aero Club of the United Kingdom. One of the striking features was the large number of exhibits of heavy motor-wagons and motor-omnibuses, the collection of such vehicles being the largest yet brought together under one roof. Another interesting portion of the show was the special aeronautical exhibit. As regards the electrical cars on view, the number was not very large, but several new types were introduced for the first time. One of these was that shown by the Ekstromer Accumulator Co., Ltd., of 13, Walbrook, London, E.C., the feature of which is the new Ekstromer accumulator, for which a large output, combined with light weight and ability to withstand sudden rapid discharges without injury, are claimed. No technical details of the construction of the battery are so far available, but tests made by independent experts show that it has a capacity of 7·08 ampere-hours per lb. of cell and a watt-hour discharge of 14·1 per lb. weight of complete cell, these being the average figures resulting from three charges and discharges at high discharge rates. The car on view was a two-seated one provided with a 5-H.P. shunt-wound motor, which drives by spur gearing a differential countershaft, which in turn is connected with the rear road wheels by side chains. The controller is adapted to give three forward and one reverse speed. Early this year an official trial of the vehicle was made. The car was fitted with a battery of 48 Ekstromer cell, and when London was left at 7.50 a.m., the E.M.F. of the cells was 100 volts. Wind and rain, together with heavy roads, impeded progress very considerably; in fact, the weather was so bad that it was impossible to keep a record of the ampere meter. The entire run of 57⅜ miles to Petersfield occupied 5 hours 30 minutes. On the return journey of 63 miles, a record of the ampere-meter was kept, readings being taken every five minutes; the total consumption of electricity was 230 ampere-hours, the discharge rate at times being 90 amperes. The large consumption is accounted for by the condition of the roads. The route taken was the Portsmouth Road, over Hind Head, and each journey was made on a single charge.

The Alexandra electrical carriage exhibited by the Phœnix Carriage Co., Ltd., of Aston Road, Birmingham, was not only a newcomer in the electromobile world, but undoubtedly formed one of the features of the show. The body, which takes the form of a four-wheel hansom cab, is provided with a detachable seat and a sliding roof, by means of which the vehicle can be converted into a covered car for four persons. The arrangement of the doors and windows is exceedingly ingenious, they having been so designed as to fall outwards in case of accident. The frame is of special tubular construction terminating about mid-length of the car. The electrical energy is furnished by a battery of 44 accumulators carried at the rear. A series-wound motor drives by spur-gearing a differential countershaft, which in turn drives the rear road wheels through side chains. The controller is adapted to give two forward speeds and one reverse. The steering gear is of novel design, the front wheels being mounted on a fixed axle, which in turn is connected with a large plate turntable. It is claimed that the arrangement permits of a large lock, so allowing the vehicle to turn in a much smaller circle than usual.

Another interesting electrical vehicle on view was the "Silvertown," shown at the stand of Messrs. W. & F. Thorn. This vehicle, which we have already described, is built by the well-known Silvertown Co., and is noteworthy from the point of view of solidity of construction. The frame is made of one piece of channel steel with a single joint, all corners being solid. An unusual feature is the four-wheel drive, which is obtained by fitting a 2½-H.P. motor and differential to both front and rear axles. At present a battery of 44 E.P.S. cells having a capacity of 160 ampere hours at a five-hour rate, and allowing a run of 35 miles over good roads on a single charge, is being used. The controller is adapted to give eight forward speeds, five braking positions, and five reverse points, all controlled by one lever.

Messrs. Mors, Ltd., of Shaftesbury Avenue, W.C., who have acquired the British agency for the Cardinet electrical vehicles of the Compagnie Française des Voitures Electromobiles, exhibited a neatly finished coupé. The motor is provided with two fields and two armatures, by means of which four speeds are obtained without altering the battery connections, the cells remaining in series the whole time. The controller is adapted to give four forward speeds, one reverse and an electrical braking position.

The Krieger Electric Carriage Syndicate were also present with a couple of Krieger cars, one being a victoria, and the other a double landaulette. This system has already been described in our columns, but it may be briefly mentioned that two 4½-H.P. combined electric motors drive the front road wheels through spur gearing. The electrical energy is furnished by a battery of 44 Fulmen or Société de Métaux accumulators, one charge of which is stated to be capable of running the vehicle a distance of 45 miles. We understand that over 50 Krieger electric cars are now in use in the London district.

There were quite a large number of exhibitors of electrical accessories in the way of coils, accumulators, sparking plugs, contact breakers, &c., for ignition purposes on petrol cars. The High-Tension Co., of Charlton, S.E., introduced a new multi-cylinder coil which is claimed to be capable of giving a 10-in. spark. Messrs. J. C. Fuller & Son, of Bow, E., in addition to accumulators and coils, are making a speciality of a small combined engine, dynamo and switchboard for charging ignition accumulators, which should be found useful by motor-car agents who are some distance away from a central electric lighting station. Messrs. Kuttner and Macdonell exhibited a new petrol electric motor-car, which appears to have a number of interesting features. The motive power is supplied by a two-cylinder petrol engine, the power of which, instead of being utilised direct, serves to operate through a dynamo two electrical motors, each of which is connected by spur gearing to a rear road wheel. The company known as Le Carbone had on view a new primary battery, suitable for ignition purposes, the feature being that it will last indefinitely when not in use, so that it may be employed as a reserve battery for cars having either magneto or accumulator ignition. When it is required to use the battery, all that is necessary is to fill it with a sal-ammoniac solution. Other exhibitors of electrical ignition accessories included Messrs. J. Lacoste & Co., the Aston Motor Accessories Co., Ltd., the London Electrical Syndicate, Ltd. (Poplar), Van Raden & Co., Ltd. (Coventry), and the Prested Miners' Gas Indicating Electric Lamp Co.

The show closed on Saturday last.

**Ignition as Applied to Internal Combustion Engines.**—At the second ordinary meeting of the Automobile and Cycle Engineers' Institute, held at the Institution of Mechanical Engineers, Sir Oliver Lodge delivered a lecture on the above subject. He surveyed the matter from a general and scientific point of view, illustrating the lecture by many interesting experiments. In the course of his remarks, he said that electric ignition might be regarded as almost a natural method of setting up combustion, because combustion, after all, was only electrical action. The force of chemical activity was electrical attraction at close quarters—an electric attraction between molecules. The lecturer introduced his own improved method of ignition, which differs from the present high tension system by coil, in that instead of the high-tension current from the coil being taken direct to the plugs it is taken to Leyden jars, and the tertiary current from the outer coats alone is conducted to the plugs. The Leyden jar or condenser acts in a way analogous to that of a spring and stores up the current gradually, throwing it out again with violence. As a result of this system, plugs were shown sparking in oil and in water, and generally reversing the ideas which at present prevail as to their treatment. It was suggested that in marine work and in large engines, the Lodge system would be found extremely valuable. A member, in seconding the vote of thanks to the lecturer, remarked that the author's experiments appeared to go a long way towards solving troubles in launch work, where the installation of H.T. circuits was exceedingly difficult; the author's coil would also be useful in that connection.

## VISITORS' DAY AT BUSHY HOUSE.

The invitation, issued by the Board of the National Physical Laboratory, to the annual inspection of Bushy House, was accepted by a considerable number of visitors; and although the weather on the 17th inst. was particularly adverse to the occasion, the arrangements made by the Director and his staff resulted in a pleasant afternoon for everybody who took this opportunity of observing the progress of that institution. Considering the shortness of the period that has elapsed since the building was transformed from a private residence, the nation may congratulate itself upon the advance that has been made in the equipment. Viewed from without, Bushy House on Friday still appeared with unpretentious homeliness, much like an old mansion with new stables. Viewed from within, it resembled no other building. This is perhaps explained by the circumstance that the National Physical Laboratory is the nearest approach the nation has yet sought to make to a temple of truth. The desire for precision already stamps this interior with a character that promises to develop into a beauty of its own, a charm that the nation is only just beginning to appreciate; if this endeavour is faithfully supported, we shall see it grow into something which will confer loftier motives, if not bigger profits, upon the age.

The aims and progress of the National Physical Laboratory were ably dealt with by Dr. Glazebrook in the paper read before Section A of the British Association last year. It was interesting to see apparatus to which he referred in that paper. Some idea of the work already accomplished may be gathered from the fact that the Laboratory has established a scale of temperature to 1,000° C., probably correct to a few tenths of a degree at that temperature, and it has materialised a standard of resistance which is in agreement with the Reichsanstalt standards to two parts in 100,000. Moreover, experiments undertaken by the engineering department have indicated the probability that the resultant force due to wind pressure is proportional to the square of the linear dimensions of a structure against which it impinges. High-class research in regard to steel and iron is being undertaken with conspicuous success, and every department of the laboratory is actively engaged. The tests appertaining to what may be regarded as routine work now comprise electrical and magnetic investigations of all kinds, thermometry, metrology, mass and volume tests, photomicrography, chemical analysis, and optical measurement.

Of new features, we noticed first of all the chemical laboratory, modestly occupying what was formerly the chapel of Bushy House, and still preaching of good intentions. This laboratory is, we have reason to know, doing splendid work, but it is obviously lacking in equipment; it is to be hoped that the chemical industry will supply the means for an adequate representation of the science at Teddington. The historical piece of mechanism invented by Lord Kelvin for predicting the times of tides has been transferred from India to the National Physical Laboratory, and it is working as perfectly as on the day it was made. It combines automatically about 24 harmonic components, and in about two hours it draws the curve of tides for any open coast station for each day of a year. Another delightful piece of mechanism, among many, is the dividing engine made by the Société Genevoise for the construction of instruments of precision. We noticed also some good work in progress in regard to the gauging of shafts and bearings with a view to determining the clearance necessary for "running fits." The nickel alloy known as Invar was in evidence as an H-form four-metre line standard, and in other forms. Photometry has received careful attention, and there was a good display of standard lamps and photometers, applicable to various conditions of testing. In the engineering department there was a very effective plant for calibrating steam gauges. Machines for subjecting materials to stresses of various kinds have also been erected, but there is space for a great deal more. Research work was here represented by a complete apparatus by which it is hoped to determine definitely the law of the specific heat of superheated steam. The electrical laboratories and the thermal laboratories have proved their value by the excellent work to which we have already referred; it is impossible here to attempt to describe them. One of the latest determinations made there is the melting point of platinum, which we believe is now to be taken as 1,710° C.

## BIMETALLIC RHEOSTATS.

By F. PUNGA.

The choice of the proper material is one of the most important factors in the construction of rheostats; in fact, for starting rheostats where ventilation is of little importance, the problem is to directly store up a certain amount of heat in the cheapest way.

As the usual material for rheostats—wire of high specific resistance—is rather expensive, the attempt has been made

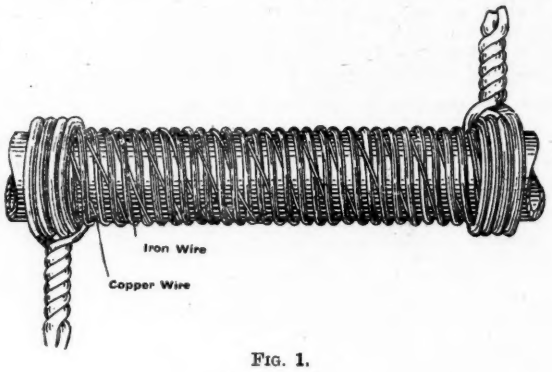



Fig. 1.

to improve the heat-storing capacity by winding the wire directly on porcelain or on iron tubes, insulated by thin sheets of asbestos, or on asbestos tubes impregnated with special chemical substances and baked.

The inherent fault of all these arrangements is the sluggishness with which the heat is taken up by the surrounding materials.

Quite a different solution of the problem is the use of iron as resistance wire. This obviates the necessity for employ-

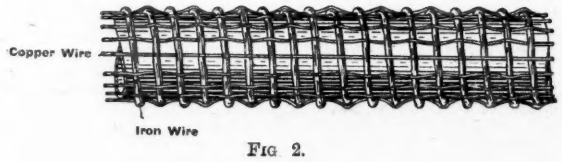



Fig 2.

ing any other heat-storing materials, as iron is so cheap that a liberal quantity may be employed in the design.

This method has, however, a great lack of flexibility. Whilst very useful for currents up to 5 or 10 amperes, it is impracticable for larger currents to use one single wire, as the cross-section would be too large for bending, and one has to employ two or three, and often as many as six, different wires in parallel.

This leads to a series of disadvantages, especially if a good many steps are employed for the rheostat switch, as taps often have to be taken from the middle of a tube. If there are, say, six tubes in parallel, this means six taps for one rheostat step.

A solution, which is to a certain extent free from the faults of the above methods, has been devised by Mr. Hobart, and the writer has helped in the development of this so-called "bimetallic rheostat." The chief material for storing up the heat is iron, but the current is conducted almost entirely by a copper winding, which is in close metallic contact with the iron wire. The latter is able to absorb the heat from the copper very quickly; in fact, tests have shown that the copper winding can be designed quite independently of thermal considerations; the cross-section can be chosen so small that the wire would fuse instantaneously if suspended in free air.

The current density employed in a copper wire of 0·27 mm. was 250 amperes per sq. mm., or 150,000 amperes per

sq. in., and after 120 seconds the temperature of the wire was only just high enough to soften common solder.

By this means it is possible to obtain a rheostat in which the heating is taken care of by the iron wire, and the exact resistance is obtained by choosing the copper of different cross-section. As the iron wire is preferably always of one

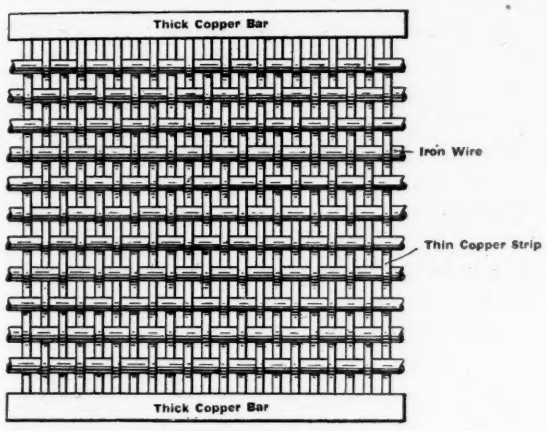



Fig. 3.

and the same diameter, the copper cross-section being, however, very small, the general appearance of a rheostat for 15 amperes is about the same as one for 75 amperes.

In the normal rheostats the iron wire is wound with about 6 turns per cm. length; the copper wire two or three in parallel, having only one-half turn per cm. length of tube. Iron wire and copper wire are in parallel, but as the former has a considerably greater length and considerably higher specific resistance, only a small percentage—often from 5 to 15 per cent.—of the total current flows through the iron wire. This construction is shown in fig. 1; the maximum current that can be conveniently carried in this way is about 100 or 150 amperes. Fig. 2 shows a tube for 125 amperes. It will be noticed that the greater the current the steeper

Fig. 4.

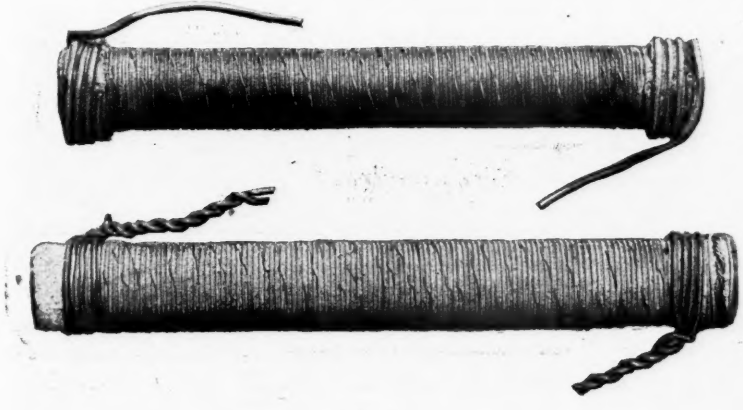


Fig. 5.

becomes the pitch with which the copper wire is wound. For higher currents, the construction in fig. 3 * is used, which construction, in the form of honeycombs, can be used for almost any current.

The winding of the tubes shown in figs. 4 and 5 has been done by hand, but, of course, to reduce labour cost, machine-wound rheostats would be employed in the factory, and suitable terminal caps would also be substituted for the twisted wires shown. The iron and copper wires can either be woven through each other in the manner familiar in covering copper wires with cotton insulation, or they could be wound in three stages:—(1) One spiral of iron wire; (2) The copper winding; (3) A second spiral of iron winding between the turns of the first spiral.†

The winding itself is, however, not done for each tube separately, as is a necessary condition for the ordinary rheostats, but may be done in large quantities, 10 or 20 being wound in one continuous piece; terminals are wound round at suitable distances apart after the total length is wound, and then single tubes are sawn out.

As there are generally no tubes in parallel, it is clear that the distance between two adjacent taps must be as many times larger as there are tubes in parallel for the ordinary construction; or, in other words, the length of a single tube can be chosen considerably larger than in the normal rheostats, and even then no taps from the middle of a tube will be necessary.

* A similar construction has already been devised by Siemens and Halske, D.R.P. 26,175. In contrast to the above construction, however, it uses high resistance wires for carrying the current.

† This proposal is due to Mr. F. E. Kennard.

## THE BOSTON TURBO-GENERATOR STATION.

The most recent American practice in turbo-driven generating stations is exemplified in the recently-erected new power house of the Boston Edison Electric Illuminating Co., which is at present of 10,000 kw. capacity, and is to have an ultimate capacity of 60,000 kw. The saving of space effected by the use of the vertical turbines is shown by the fact that, although the cheapness of ground allows the buildings to be spread out rather than carried high, and the turbine room receives all the machinery of the station, including the boiler feed pumps (the boiler house only containing the boilers and necessary piping), yet the turbine room floor area is only 36,725 sq. ft., as against 95,680 sq. ft. boiler house area. The two buildings are of the same height, and there is no basement. A separate switchroom of several storeys is provided. The finished building will cover about 160,000 sq. ft., or 2·67 sq. ft. per kw.

The detached unit system is almost completely adhered to, each generating unit with its auxiliary plant being a small central station in itself. The steam mains of pairs of units are joined by a small cross-pipe for temporary runs in case of emergency, this being the only divergence from strict detachment. The points that decided the use of turbines as against reciprocating engines were their smaller first cost, smaller operating expense in supervision, less room required, ability to start up quickly, and purity of condensing water. These were held to be of much more importance than economy of steam consumption, the value of which, though expected to be better than that of the reciprocating engine, is doubtful.

The 5,000-kw. four-stage Curtis turbines have surface condensers in their bases, and mechanical brakes for emergency shut-downs. Without this the turbine will run for some hours with no-load and no field. All auxiliaries—the circulating pump, wet and dry vacuum pump, step-bearing pump, hydraulic accumulator, and boiler feed pump—are steam driven (for better economy than with motor-drive) excepting the wet pump, which has too high a speed for a steam engine. The step is lubricated by water at 1,000 lb. per sq. in. pressure. The rows of boilers, placed in pairs back to back, with a chimney 230 ft. high between and half-way along each pair of rows, are elevated from the ground to give space beneath for ash handling. Each row supplies one turbine, the arrangement giving the minimum length of pipe.

Superheaters, but not economisers, are installed, the latter being rejected, as their effect on the chimney draught reduces the boiler capacity at the time when the maximum is needed, unless they are cut out of action at a time when they would

be most useful. Coal is stored in the open air immediately on the ground and without shelter, provision for 60,000 to 70,000 tons being made. In the switchroom, owing to exigencies of previous supply, there are three bus-bar pressures—2,300 volts from the old station, 6,900 from the new turbo-generators, and 4,600 volts for outlying districts on the old system. This, with the addition of the excitation and provision for future alterations to 13,800 volts, gives as complicated a three-phase switchgear problem as can be wished for.

Duplicate bus-bars are installed in each system, transmission and machine connections being collected into groups of 10,000 KW., with tie switches between the groups.

In a discussion on this plant at the American Institute of Electrical Engineers, the detached unit system was criticised on the ground that banking mechanically-stoked boilers as spares required almost as much coal as running the plant, a few cross-connections allowing a spare turbine to use the boilers already in action. The defence was that cross-connections had been tried at the Atlantic Avenue station, where every conceivable connection had been made, with the result that in a short time everyone forgot the purpose of the different connections. This seems to us to be a slur upon the American memory.

Other points questioned were the superiority of the turbine to the reciprocating engine for speedy running up, the advisability of isolating the switchboard from the turbine room, the superiority of the surface condenser to the barometric type having a dry air pump, and the advisability of storing coal in the open.

## NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

5,163. "Improvements in electrical conduit fittings." S. WITHERS, J. GRIFFIN and A. D. ROBINSON. March 13th.

5,172. "Hydraulic transmission dynamometer." A. SCOTT, Jun. March 13th.

5,197. "Improvements in electric switches." M. BYNG and H. J. COATES. March 13th.

5,205. "Improvements in and relating to trolleys for electric tramcars and the like." J. W. BRADLEY and J. F. MASON. March 13th.

5,206. "Improvements in dynamo-electric machinery for continuous and alternating currents, also means of regulating same." J. P. NAYLOR. March 13th.

5,220. "Improvements in cooling devices for vapour electric apparatus." P. J. THOMAS. (Date applied for under Patents Act, 1901, March 28th, 1904, being date of application in United States.) March 13th. (Complete.)

5,226. "Improvements relating to electrically-fired internal combustion engines." W. P. LITTLE. March 13th.

5,229. "Improvements in or relating to the regenerative control of electrically propelled vehicles." J. S. RAWORTH. March 13th.

5,230. "Improvements in or relating to the regenerative control of electrically propelled vehicles." J. S. RAWORTH. March 13th.

5,231. "Improvements in or relating to the regenerative control of electrically propelled vehicles." J. S. RAWORTH. March 13th.

5,232. "Improvements in electric current circuit breakers." E. F. MOY and P. H. BASTIE. March 13th. (Complete.)

5,259. "Improvements in or relating to connectors for electrical conductors." A. B. CAREY. March 13th.

5,270. "Electric alarm. Improved apparatus for use in railway signalling and also as a fire and burglar alarm." J. JENNETT. March 14th.

5,278. "Novel or improved insulator for electric traction street poles." E. DOWNWARD and J. P. DOWNWARD. March 14th.

5,280. "Improvements connected with electrical switches, circuit breakers, motor starters and such like." VERITYS, LTD., and A. E. GOTT. March 14th.

5,295. "Electro-magnet pump." R. L. IBBETSON. March 14th.

5,336. "A device for automatically controlling air-compressors or other fluid-pressure generating apparatus driven by electric motors." J. F. MASON. March 14th.

5,357. "Improvements in or relating to the forming of glass seals, especially applicable for hermetically sealing electrical conductors into glass." C. O. BASTIAN. March 14th.

5,370. "Improvements in and relating to methods of insulating electric conductors." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) March 14th. (Complete.)

5,371. "Improvements in and relating to methods of and apparatus for insulating electrical conductors." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) March 14th. (Complete.)

5,398. "Improvements in the manufacture of pendants, brackets and other fittings for gas and for electric light." H. HATELEY. March 15th.

5,409. "Improvements in vapour electric apparatus." P. C. HEWITT. (Date applied for under Patents Act, 1901, April 9th, 1904, being date of application in United States.) March 15th. (Complete.)

5,419. "Improvements in main switches or circuit-breakers." T. R. H. TETLEY. March 15th.

5,425. "Improvements in or relating to electric furnaces." H. L. FULMAN and H. F. KIRKPATRICK-PICARD. March 15th.

5,455. "Improvements in spark-gaps for electric discharges." W. P. THOMPSON. (Gesellschaft für drahtlose Telegraphie m.b.H., Germany.) March 15th. (Complete.)

5,456. "Improvements in detectors for electro-magnetic waves or other weak electric impulses." W. P. THOMPSON. (Gesellschaft für drahtlose Telegraphie m.b.H., Germany.) March 15th. (Complete.)

5,491. "Improvements in electric radiators or heaters." S. COWPER-COLES. March 16th.

5,497. "A system of signalling between guards of a train and the engine-driver of that train by means of an electric bell or light on the engine operated by a switch at the entrance to each carriage." H. D. OSTERFIELD. March 16th.

5,520. "Improvements in or relating to electric circuit-breakers." T. E. WEAVER. March 16th.

5,553. "Improvements in and connected with electric arc lamps." V. W. RILEY and H. W. ROWING. March 16th. (Complete.)

5,554. "Improvements in or connected with the insulators of the third rail of third-rail electric traction systems." F. G. KLEINSTEUBER. March 16th.

5,568. "Improvements in balance weights for electric light pendants and the like." J. A. BAUER. March 16th.

5,577. "Improvements in telephone calls." P. T. GEYERMAN. March 16th.

5,589. "Improvements in dynamo-electric machines." P. A. J. LAPEYRADE. (Date applied for under Patents Act, 1901, March 17th, 1904, being date of application in France.) March 16th. (Complete.)

5,584. "Improvements in electric conveyor systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) March 16th.

5,585. "Improvements in and relating to vapour electric apparatus." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) March 16th.

5,588. "Apparatus for cleaning electric lamp globes." G. HONE. March 17th.

5,660. "Improvements in automatic electric make-and-break contacts." E. B. BOUCHER. March 17th.

5,662. "Improvements in and relating to track construction and electric signalling and controlling equipment therefor." G. THOMPSON and H. W. MERCHANT. March 17th. (Complete.)

5,685. "A new or improved method of electrically transmitting and indicating upon a screen the position of moving figures, moving objects, diagrams, writing and the like." J. A. KENNEDY-MCGREGOR. March 18th.

5,724. "Improvements in dynamo-electric and electro-dynamic machinery." J. GREY BELL. March 18th.

5,755. "Improvements in electric switches." K. O. SEARLE. March 18th.

5,757. "Improvements in and relating to alternating current electric motors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) March 18th. (Complete.)

5,759. "Improvements in electric clocks." G. B. BOWELL. March 18th.

5,769. "Improved construction of accumulators or secondary batteries." A. E. DAKHYL and A. GALANTI. March 18th.

5,771. "Improvements in or relating to printing telegraphs." J. C. BARCLAY. March 18th.

5,593. "Improvements in alternating and pulsating current electro-magnets and solenoids." W. J. F. COOPER. March 17th.

## PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

### 1904.

TELEPHONE ADAPTED FOR USE FOR PARTIALLY-DEAF PERSONS. C. Nathan and J. J. L. Newland. 1,081. January 15th.

ELECTRIC INCANDESCENCE ILLUMINATING APPARATUS. C. B. Francis. 1,106. January 15th.

ELECTRICAL SWITCHES. V. Hope, V. H. Sugden, and W. Gardner. 1,326. January 19th.

ALTERNATING CURRENT ELECTRIC MOTORS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 1,481. January 20th.

ALTERNATING CURRENT ELECTRIC MOTORS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 1,482. January 20th.

ALTERNATING CURRENT MOTORS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 1,483. January 20th.

CONTROLLING ELECTRIC MOTORS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 1,484. January 20th.

SHADE CARRIER HOLDER FOR BAYONET OR SCREW ELECTRIC GLOW LAMP HOLDERS. P. F. Escaré. 1,513. January 21st.

A NEW OR IMPROVED DEVICE FOR PREVENTING ACCIDENTS FROM OVERHEAD TROLLEY WIRES WHEN BROKEN. A. B. Mudie. 1,624. January 22nd.

MOTOR CONTROL SYSTEMS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 1,968. January 26th.

STATIC ELECTRICAL MACHINES FOR LIGHTING GAS, ETHER, AND THE LIKE. H. Nehmer. 2,063. January 27th.

ELECTRIC RECEIVING APPARATUS FOR TELEGRAPHIC AND OTHER PURPOSES. J. T. Armstrong & A. Orling. 2,066. January 27th.

APPARATUS FOR USE IN THE DISTRIBUTION OF ALTERNATING CURRENTS. A. F. Berry. 2,096. January 27th.

ELECTRIC INDUCTION MOTOR METERS. The Compagnie pour la Fabrication des Compteurs et Material d'Usines à Gaz. 2,098. January 27th. (Date claimed for patent under Patents Act, 1901, February 26th, 1903, being date of application in France.)

TROLLEYS FOR COLLECTING ELECTRICITY. A. Thomson. 2,243. January 29th.

ELECTRIC LOW-WATER ALARM FOR BOILERS AND THE LIKE. 2,277. January 29th.

POLARIZATION OF HERTZIAN WAVES. F. J. Green. 2,285. January 29th. (Date claimed for patent under Patents Act, 1901, January 29th, 1903, being date of application in United States.)

ELECTRIC SIGNALLING APPARATUS FOR TRAMWAYS AND RAILWAYS. R. P. Wilson & A. G. Marshall. 2,288. January 29th.

ELECTRICAL TERMINAL ATTACHMENT DEVICE. J. C. MacIver & A. F. Guy. 2,315. January 30th.

COMPOSITION FOR ELECTRICAL CONDUITS. R. Starke. 2,347. January 30th.

THE RENEWABLE CENTRE AND SELF-LUBRICATING TROLLEY PULLEY FOR OVERHEAD ELECTRIC TRAMCARS AND THE LIKE. R. Carnegie & A. Beevers. 2,397. February 1st.

EMERGENCY BRAKES FOR ELECTRICALLY-PROPELLED VEHICLES, TRAINS, AND THE LIKE. The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) 2,449. February 1st.

CONTROLLING ELECTRIC SWITCHES AND CUT-OUTS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 2,450. February 1st.

ALTERNATING CURRENT ELECTRIC MOTORS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 2,452. February 1st.

ALTERNATING CURRENT ELECTRIC MOTORS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 2,453. February 1st.

CONTROL OF ALTERNATING CURRENT ELECTRIC MOTORS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 2,455. February 1st.

MACHINES FOR TREATING FILAMENTS FOR ELECTRIC LAMPS. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 2,456. February 1st.